

**KAHEAWA WIND POWER II
WIND ENERGY GENERATION FACILITY**

**HABITAT CONSERVATION PLAN
UKUMEHAME, MAUI, HAWAI'I**

KAHEAWA WIND POWER II, LLC.

APRIL 2010

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1.0 INTRODUCTION AND PROJECT OVERVIEW

1.1 SUMMARY

Kaheawa Wind Power II LLC ("KWP II LLC" or the "Applicant"), proposes to construct and operate a new 21-megawatt (MW) wind energy generation facility near Kaheawa Pastures above Mā'alaea in the southwestern portion of the Island of Maui, Hawai'i. The proposed project, known as Kaheawa Wind Power II (KWP II), is situated on approximately 143 acres (58 ha) of State Conservation Land southeast of the existing First Wind 30-MW Kaheawa Wind Power (KWP) project. KWP commenced operation in June of 2006 (see Figure 1.1 and 1.2). Like the KWP project, KWP II would supply wind-generated electricity to Maui Electric Company Ltd. (MECO).

The project components of KWP II will consist of

- 14 General Electric (GE) 1.5-MW wind turbine generators (WTGs);
- sharing of the existing operations and maintenance building (O&M) with KWP;
- one 5,000 ft² maintenance building next to the existing KWP O&M building;
- installing a 60,000-gallon tank adjacent to the existing O&M building at KWP. If a tank is not installed, the proposed project would use bottled water and portable pumped toilets similar to the KWP I facility
- one substation;
- underground cables carrying electrical power from the individual wind generators to a new electrical substation;
- a battery energy storage system (BESS);
- an overhead electrical collection line across Manawainui Gulch connecting the collection system with the new substation;
- a short overhead electrical transmission line connecting the substation to the uppermost of the two existing MECO 69 kV transmission lines through the area;
- a communications system of underground fiber optics cables connecting to the existing KWP communications tower;
- one permanent meteorological tower and one guyed temporary 65-meter test tower erected prior to construction of the WTGs. The temporary tower will be removed within 3 months of completing construction and
- service roadways to connect the new WTGs and other facilities to the existing main access road serving KWP.

These components would disturb approximately 43 ac (17 ha) of land or approximately 30% of the project area; the remainder would remain undisturbed.

For the past two years, the Applicant has collected meteorological data at the KWP II site to determine suitable areas for the proposed WTGs. The data show that the most favorable areas are to the west and south of the KWP turbines. Because of the characteristics of the prevailing winds, constructability, and other factors, the Applicant has determined that the "Downroad" area is the best site for the KWP II project. Under the selected layout, 14 WTGs would be constructed along the existing KWP access road below the existing WTGs (see Figure 1.3).

Construction and operation of the KWP II project has potential to result in the incidental take of four federally- and state-listed threatened and endangered species: the Hawaiian petrel (*Pterodroma sandwichensis*), Newell's shearwater (*Puffinus auricularis newelli*), nēnē or the Hawaiian goose (*Branta sandvicensis*), and Hawaiian hoary bat (*Lasiurus cinereus semotus*). Hereafter, these four species are collectively referred to as the "Covered Species." These species are known to fly in the vicinity of the project area and could be injured or killed if they collide with a WTG or other project component. No other listed, proposed, or candidate species have been found or are known or expected to be present in the project area. Adjusted take estimates at KWP II for all species take into account both direct and indirect take. Direct take comprises individuals that are killed or injured colliding with turbines or associated structures on site. Indirect take considers that it is possible that adult birds killed through on-site collisions could have been tending to eggs, nestlings, or dependent fledglings or adult bats could have been tending to dependent juveniles. In such cases, the loss of these adults would then also lead to the

loss of the eggs or dependent young. Loss of eggs or young would be “indirect take” attributable to the proposed project. Observed direct takes documented at the existing KWP facility include one Hawaiian petrel, three nēnē and one Hawaiian hoary bat.

The Applicant is seeking an Incidental Take Permit (ITP) in accordance with Section 10(a)(1)(B) of the federal Endangered Species Act (ESA) of 1973, as amended, and an Incidental Take License (ITL) in accordance with Chapter 195-D, Hawai'i Revised Statutes. These permits are issued by the U.S. Fish and Wildlife Service (USFWS) and State Department of Land and Natural Resources (DLNR), respectively. The requested take for KWP II is summarized in the table below.

Table 1.1 Requested Take for KWP II at Baseline and Higher Tiers

Common Name	Scientific Name	Tier	Annual Take Limit	Five Year Take Limit	Twenty Year Take Limit
'Ua'u (Hawaiian petrel)	<i>Pterodroma sandwichensis</i>	Baseline	4 adults/immatures and 3 chicks/eggs	8 adults/immatures and 5 chicks/eggs	18 adults/immatures and 11 chicks/eggs
		Higher	up to 8 adults/immatures and 5 chicks/eggs	up to 12 adults/immatures and 8 chicks/eggs	up to 27 adults/immatures and 17 chicks/eggs
'A'o (Newell's shearwater)	<i>Puffinus auricularis newelli</i>	Baseline	4 adults/immatures and 2 chicks/eggs	6 adults/immatures and 3 chicks/eggs	10 adults/immatures and 4 chicks/eggs
		Higher	up to 6 adults/immatures and 3 chicks/eggs	up to 9 adults/immatures and 4 chicks/eggs	up to 15 adults/immatures and 6 chicks/eggs
Nēnē (Hawaiian goose)	<i>Branta sandvicensis</i>	Baseline	4 adults/immatures and 1 fledgling	8 adults/immatures and 1 fledgling	18 adults/immatures and 2- 3 fledglings
		Higher	up to 6 adults/immatures and 1 fledgling	up to 12 adults/immatures and 3 fledglings	up to 27 adults/immatures and 3 fledglings
'Ōpe'ape'a (Hawaiian hoary bat)	<i>Lasiurus cinereus semotus</i>	Baseline	4 adults/immatures and 3 juveniles	10 adults/immatures and 8 juveniles	12 adults/immatures and 9 juveniles
		Higher	up to 8 adults/immatures and 6 juveniles	up to 12 adults/immatures and 9 juveniles	up to 18 adults/immatures and 14 juveniles

This HCP supports the issuance of these permits, and describes how the Applicant will avoid, minimize, mitigate, and monitor the incidental take of threatened and endangered species that may occur during construction and operation of the proposed project. Efforts to minimize the potential impacts that the facility may have on these listed species have already been incorporated into the site design and configuration. The general and species-specific mitigation measures the Applicant is proposing are intended to increase knowledge of the species' biology and distribution, enhance populations, or restore degraded native habitat. Mitigation measures are required to provide a net benefit to the species as required under state law. Mitigation measures are briefly summarized in the table below for the Covered Species.

Table 1.2 Proposed Mitigation for Covered Species: Baseline, and Higher Take Scenarios

	Baseline mitigation	Higher
Seabirds	Mitigation for Newell's shearwater and Hawaiian petrel at Makamaka'ole or other suitable seabird nesting sites on Maui or Kauai or elsewhere. Mitigation measures to include fencing, predator trapping or social attraction at the selected seabird colony(s).	Increased mitigation efforts at the same site or additional mitigation measures at one or more additional sites on Maui or Kauai or elsewhere
Nēnē	<p>1. Fund the captive propagation of seven to ten nēnē goslings per year for the first three to four years of project operations for reintroduction at a suitable nēnē release site, regardless of take. Provide support for logistics, DOFAW staffing and release of goslings per same or similar cost structure as KWP.</p> <p style="text-align: center;">OR</p> <p>2a. Predator trapping on state conservation lands within and adjacent to the KWP project area and Hana'ula release site, to protect Hana'ula nene populations and increase adult and fledgling survival.</p> <p>2b. Support annual census and banding of birds by DLNR to document population trends and estimates of nesting success. Couple with in-kind field support from KWP II staff.</p> <p>2c. Develop a nēnē management plan for Hana'ula, KWP, and KWP II.</p> <p>2d. If additional mitigation is needed to provide a net conservation benefit, implement habitat improvement at Hana'ula or elsewhere near Kaheawa Pastures, as identified and recommended, (e.g. supplemental water, mowing).</p>	<p>1. Fund the captive propagation for the release of 17 more nēnē goslings for reintroduction at a suitable nēnē release facility. Provide support for logistics, DOFAW staffing, and release of goslings.</p> <p style="text-align: center;">OR</p> <p>2. Additional habitat improvement at Hana'ula or elsewhere near Kaheawa pastures, as identified and recommended (e.g. supplemental water, mowing).</p>

Table 1.2 Proposed Mitigation for Covered Species: Lower, Baseline, and Higher Take Scenarios (continued)

Hawaiian Hoary Bat	Baseline mitigation	Higher
	<p>1a. In-house research to document bat occupancy at different habitat types (e.g. ridges vs gulches) and elevational ranges at KWP II and vicinity to support Maui bat research.</p> <p>1b. \$25,000 up to a maximum of \$150,000 for management of bat habitat</p>	<p>1a. Continue in-house research to document bat occupancy at different habitat types (e.g. ridges vs gulches) and elevational ranges at KWP II and vicinity to support Maui bat research..</p> <p>1b. Additional funding of \$15,000 up to a maximum of \$75,000 for management of bat habitat</p> <p>1c. Implementation of low-wind speed curtailment</p>

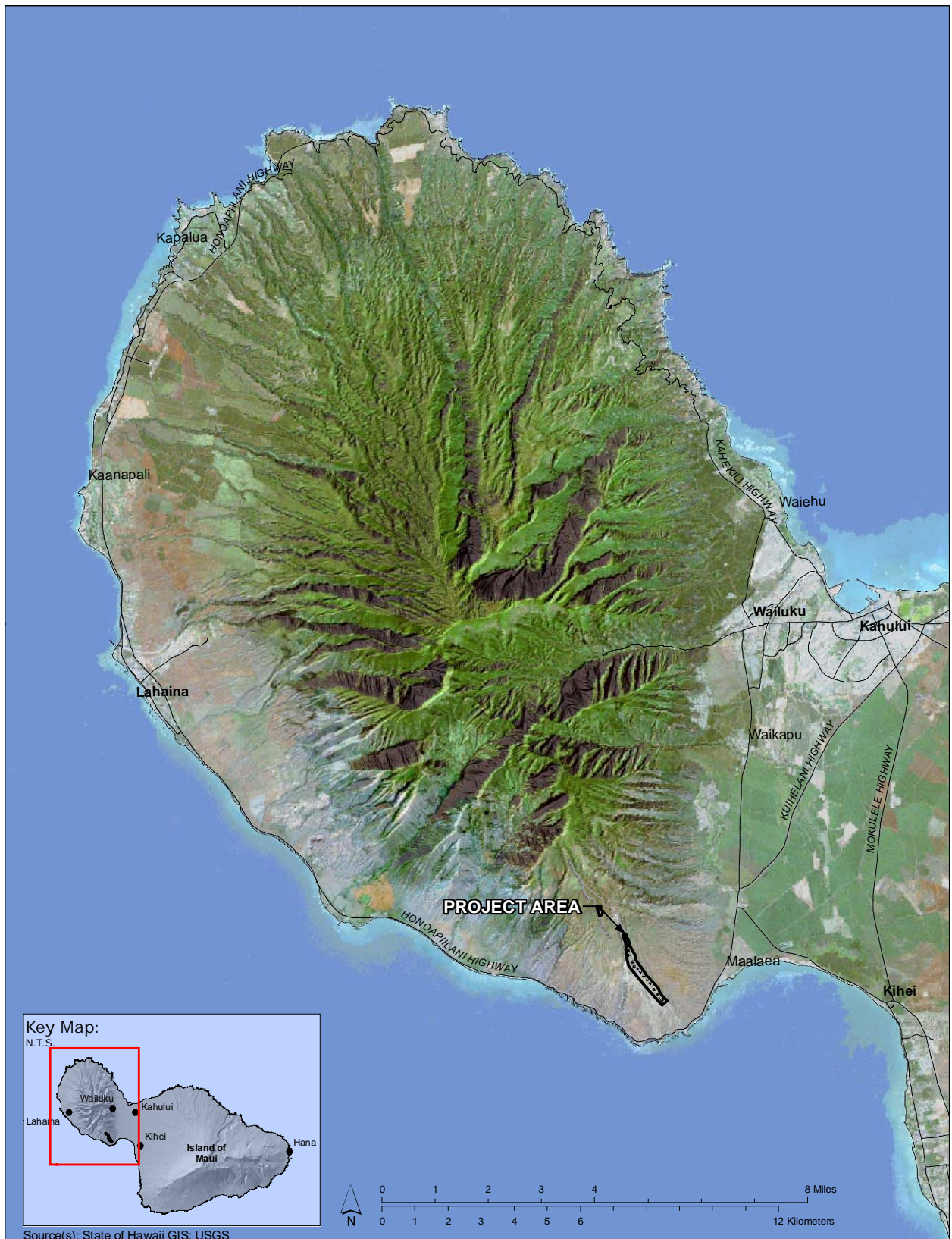


Figure 1.1. KWPII Project Location Map

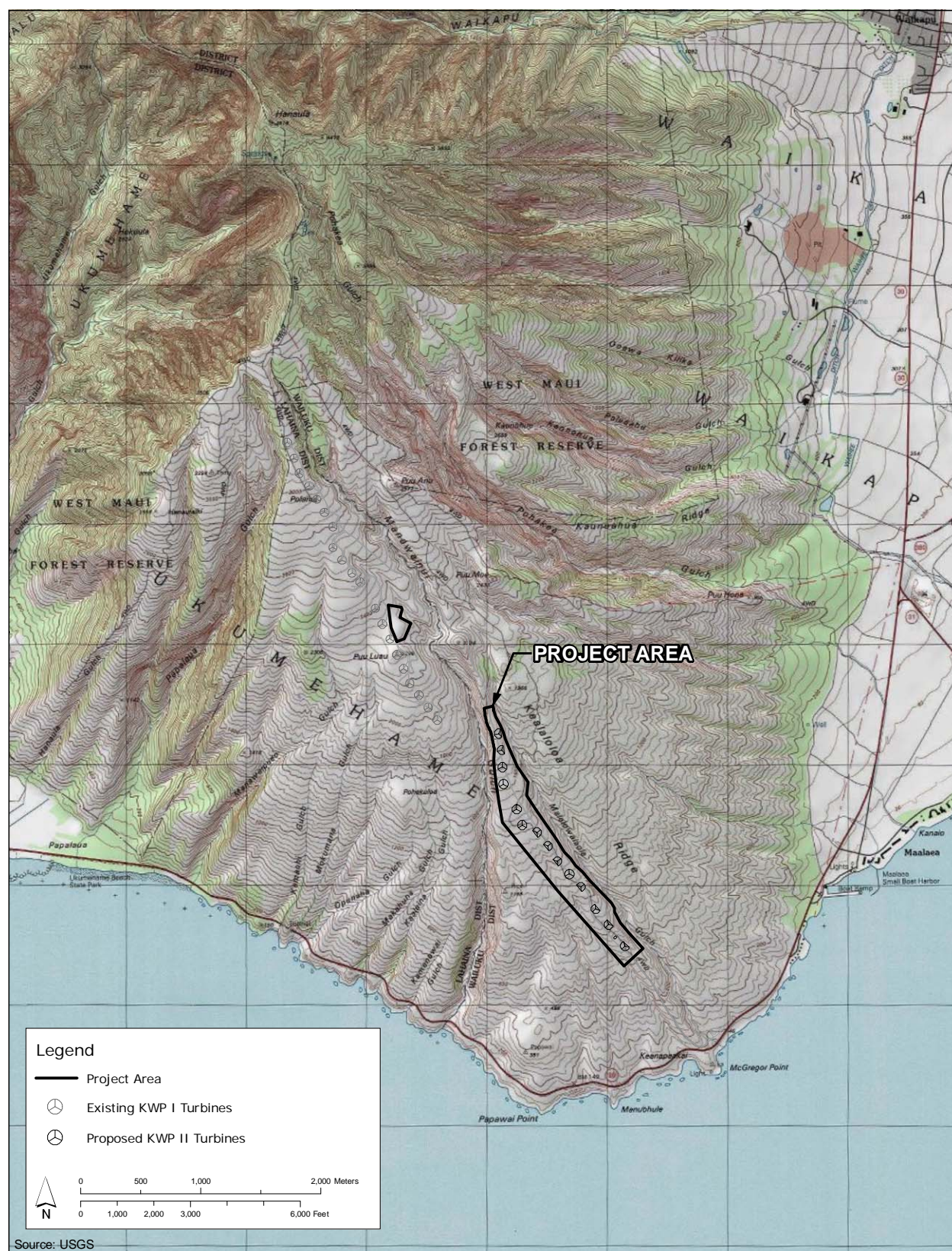
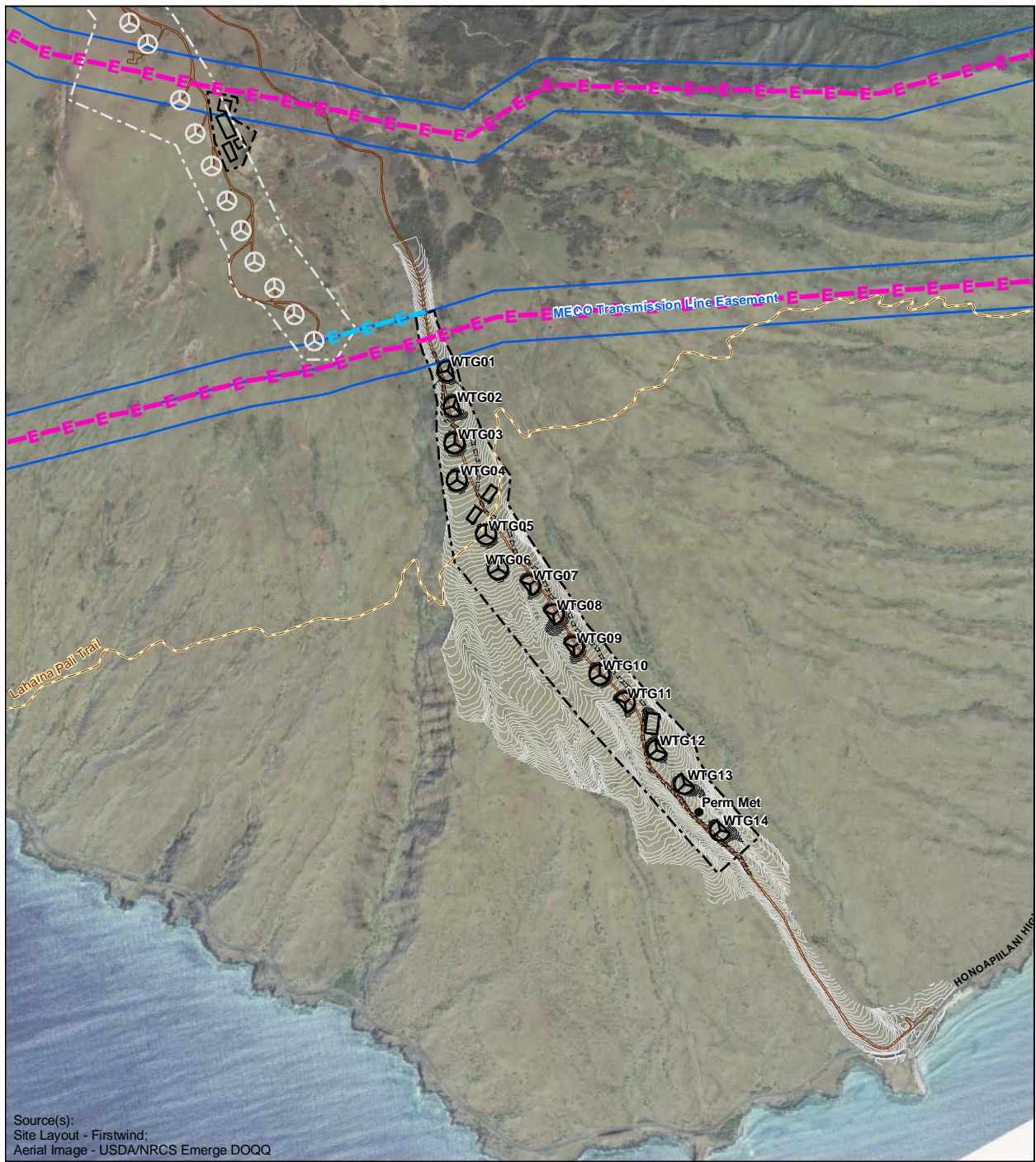


Figure 1.2. Map of the Vicinity of KWP II



Legend











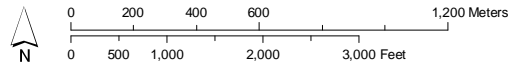
-  Proposed KWP II Turbines
-  Existing KWP I Turbines
-  KWP II Project Area
-  KWP Project Area
-  Proposed Buildings
-  Existing MECO Overhead Transmission Line
-  Proposed Overhead Transmission Line
-  Proposed Road
-  10' Contour Lines
-  10' Graded Countour Lines

Figure 1.3. Site layout



Additionally, the HCP outlines a monitoring protocol to determine the actual take of each species after the facility begins operating. Most importantly, this HCP incorporates adaptive management provisions to allow for modifications to the mitigation and monitoring measures as knowledge is gained during implementation.

1.2 APPLICANT BACKGROUND

KWP II LLC was formed by Hawai'i Holdings LLC, which comprises two entities, First Wind and Makani Nui Associates, LLC. First Wind is a Boston-based wind energy company. Makani Nui Associates, LLC is a Maui-based partnership providing local resources for the project. KWP II LLC was created for the express purpose of developing a new wind generation facility adjacent to KWP. The principals of First Wind are among the world's leading wind power developers with extensive experience in financing, constructing, operating, and managing large wind energy projects in America and worldwide. In North America, First Wind has a portfolio of over 3,000 MW of wind energy generation under development.

1.3 REGULATORY CONTEXT

1.3.1 Federal Endangered Species Act

Section 9 of the ESA prohibits the unauthorized "take" of any endangered or threatened species of fish or wildlife listed under the ESA. Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect species listed as endangered or threatened, or to attempt to engage in any such conduct. "Harm" in the definition of "take" in the ESA means an act which actually kills or injures wildlife, and may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). "Harass" in the definition of take in the ESA means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3).

The USFWS may permit, under certain terms and conditions, any taking otherwise prohibited by Section 9 of the ESA if such taking is incidental to the carrying out of an otherwise lawful activity. To apply for an ITP, an applicant must develop, fund, and implement a USFWS-approved HCP to minimize and mitigate the effects of the incidental take. Such take may be permitted provided the following issuance criteria of ESA Section 10(a)(1)(B) and 50 CFR §17.22(b)(2) and 50 CFR §17.32(b)(2) are met:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings;
- The applicant will ensure that adequate funding for the conservation plan and procedures to deal with unforeseen circumstances will be provided;
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and
- Other necessary or appropriate measures required by the Secretary of the Interior, if any, will be met.

To obtain an ITP, an applicant must prepare a supporting HCP that provides the following information described in ESA Section 10(a)(2)(A) and 50 CFR 17.22(b)(1) and 50 CFR §17.32(b)(1):

- The impact that will likely result from such taking;

- The measures the applicant will undertake to monitor, minimize, and mitigate such impacts, the funding that will be available to implement such measures, and the procedures to be used to deal with unforeseen circumstances;
- The alternative actions to such taking the applicant considered and the reasons why such alternatives are not proposed to be utilized; and
- Such other measures that the Director of the USFWS may require as necessary or appropriate for purposes of the plan.

The *Habitat Conservation Planning and Incidental Take Permit Processing Handbook*, published by the USFWS and the National Marine Fisheries Service (NMFS) in November 1996, provides additional policy guidance concerning the preparation and content of HCPs. The USFWS and NMFS published an addendum to the *HCP Handbook* on June 1, 2000 (65 FR 35242) (USFWS and NOAA 2000). This addendum, also known as the Five-Point Policy, provides clarifying guidance for the two agencies in issuing ITPs and for those applying for an ITP under Section 10. The five components addressed in the policy are discussed briefly below:

Biological Goals and Objectives: HCPs must include biological goals (broad guiding principles for the conservation program – the rationale behind the minimization and mitigation strategies), and biological objectives (the measurable targets for achieving the biological goals). These goals and objectives must be based on the best scientific information available and are used to guide conservation strategies for species covered by the plan.

Adaptive Management: The Five-Point Policy encourages the development of adaptive management plans as part of the HCP process under certain circumstances. Adaptive management is an integrated method for addressing biological uncertainty and devising alternative strategies for meeting biological goals and objectives. An adaptive management strategy is essential for HCPs that would otherwise pose a significant risk to the Covered Species due to significant information gaps.

Monitoring: Monitoring is a mandatory element of all HCPs under the Five-Point Policy. As such, an HCP must provide for monitoring programs to gauge the effectiveness of the plan in meeting the biological goals and objectives, and to verify that the terms and conditions of the plan are being properly implemented.

Permit Duration: Under existing regulations, several factors are used to determine the duration of an ITP, including the duration of the applicant's proposed activities and the expected positive and negative effects on Covered Species associated with the proposed duration. Under the Five-Point Policy, the USFWS will also consider the level of scientific and commercial data underlying the proposed operating conservation program, the length of time necessary to implement and achieve the benefits of the operating conservation program, and the extent to which the program incorporates adaptive management strategies.

Public Participation: Under the Five-Point Policy guidance, the USFWS announced its intent to expand public participation in the HCP process to provide greater opportunity for the public to assess, review, and analyze HCPs and associated documentation (e.g., National Environmental Policy Act (NEPA) review). As part of this effort, the USFWS has expanded the public review process for most HCPs from a 30-day comment period to a 60-day period.

1.3.2 Federal National Environmental Policy Act

Issuance of an ITP is a federal action subject to compliance with the National Environmental Policy Act (NEPA). The purpose of NEPA is to promote agency analysis and public disclosure of the environmental issues surrounding a proposed federal action in order to reach a decision that reflects NEPA's mandate to strive for harmony between human activity and the natural world. The scope of NEPA goes beyond that of the ESA by considering the impact of a federal action on non-wildlife resources such as water quality, air quality, and cultural resources. The USFWS will prepare and provide for public review an Environmental Assessment (EA) to evaluate the potential

environmental impacts of issuing an ITP and approving the implementation of the proposed KWP II HCP. The purpose of the EA is to determine if ITP issuance and HCP implementation will significantly affect the quality of the human environment. If the USFWS determines significant impacts are likely to occur, a comprehensive Environmental Impact Statement (EIS) for the proposed action will be prepared and distributed for public review; otherwise, a Finding of No Significant Impact (FONSI) will be issued. The USFWS will not make a decision on ITP issuance until after the NEPA process is complete.

1.3.3 Federal Migratory Bird Treaty Act

All three bird species addressed in this HCP are also protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC 703-712). The MBTA prohibits the take of migratory birds. A list of birds protected under MBTA implementing regulations is provided at 50 CFR §10.13. Unless permitted by regulations, under the MBTA it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product.

The MBTA provides no process for authorizing incidental take of MBTA-protected birds. However, if the HCP is approved and USFWS issues an ITP to the Applicant, the terms and conditions of that ITP will also constitute a Special Purpose Permit under 50 CFR §21.27 for the take of the Hawaiian petrel, Newell's shearwater, and nēnē under the MBTA. Therefore, subject to the terms and conditions to be specified in the ITP, if issued, any such take of the three listed bird species also will not be in violation of the MBTA. However, because the MBTA provides for no incidental take authorization, other MBTA-protected birds that are not protected by the ESA and that may be adversely affected by the proposed wind facility will not be covered by any take authorization.

To avoid and minimize impacts to MBTA-protected species, the KWP II project incorporates design and operational features based on the USFWS Interim Guidance on Avoiding and Minimizing Impacts to Wildlife from Wind Turbines (issued May 13, 2003). These guidelines contain materials to assist in evaluating possible wind power sites, wind turbine design and location, and pre- and post-construction research to identify and/or assess potential impacts to wildlife. Specific measures that have been adopted by KWP II to avoid and minimize the potential for impacts to MBTA-protected species are detailed in Section 4.3.

1.3.4 Federal National Historic Preservation Act

USFWS issuance of an ITP under ESA Section 10(a)(1)(B) is considered an "undertaking" covered by the Advisory Council on Historic Preservation and must comply with Section 106 of the National Historic Preservation Act (NHPA) (36 CFR §800). The undertaking is defined as the land-use activity that may proceed once an ITP is issued to an Applicant. Section 106 requires USFWS to assess and determine the potential effects on historic properties that would result from the proposed undertaking and to develop measures to avoid or mitigate any adverse effects. Accordingly, USFWS must consult with the Advisory Council on Historic Preservation, the State Historic Preservation Officer (SHPO), affected Tribes, the applicant, and other interested parties, and make a good-faith effort to consider and incorporate their comments into project planning.

The USFWS will determine the "area of potential effects" associated with the proposed undertaking, which is usually defined as the geographic area where the undertaking may directly or indirectly change the character or use of historic properties included in or eligible for inclusion in the National Register of Historic Places. The USFWS generally interprets the area of potential effects as the specific location where incidental take may occur and where ground-disturbing activities may affect historic properties. The USFWS, in consultation with the SHPO, must make a reasonable and good-faith effort to identify undiscovered historic properties. The USFWS also determines the extent of any archeological investigations that may be required; the cost of NHPA compliance, however, rests with the Applicant.

1.3.5 State Endangered Species Legislation (Chapter 195D, Hawai'i Revised Statutes)

Section 195D-4, Hawai'i Revised Statutes (HRS), states that any endangered or threatened species of fish or wildlife recognized by the ESA shall be so deemed by State statute. Like the ESA, the unauthorized "take" of such endangered or threatened species is prohibited [§195D-4(e)]. The definition of "take" in Section 195D-2, HRS, mirrors the ESA definition.

Under §195D-4(g), the Board of Land and Natural Resources (BLNR), after consultation with the State's Endangered Species Recovery Committee (ESRC), may issue a temporary license (subsequently referred to as an "ITL") to allow a take otherwise prohibited if the take is incidental to the carrying out of an otherwise lawful activity.

In order to qualify for an ITL, the following must occur:

- The applicant minimizes and mitigates the impacts of the take to the maximum extent practicable (i.e., implements an HCP);
- The applicant guarantees that adequate funding for the HCP will be provided;
- The applicant posts a bond, provides an irrevocable letter of credit, insurance, or surety bond, or provides other similar financial tools, including depositing a sum of money in the endangered species trust fund created by §195D-31, or provides other means approved by BLNR, adequate to ensure monitoring of the species by the State and to ensure that the applicant takes all actions necessary to minimize and mitigate the impacts of the take;
- The plan increases the likelihood that the species will survive and recover;
- The plan takes into consideration the full range of the species on the island so that cumulative impacts associated with the take can be adequately assessed;
- The activity permitted and facilitated by the license to take a species does not involve the use of submerged lands, mining, or blasting;
- The cumulative impact of the activity, which is permitted and facilitated by the license, provides net environmental benefits; and
- The take is not likely to cause the loss of genetic representation of an affected population of any endangered, threatened, proposed, or candidate plant species.

Section 195D-4(i) directs DLNR to work cooperatively with federal agencies in concurrently processing HCPs, ITLs and ITPs. Section 195D-21 deals specifically with HCPs and its provisions are similar to those in federal regulations. HCPs submitted in support of an ITL application must:

- Identify the geographic area encompassed by the plan; the ecosystems, natural communities, or habitat types within the plan area that are the focus of the plan; and the endangered, threatened, proposed, and candidate species known or reasonably expected to be present in those ecosystems, natural communities, or habitat types in the plan area;
- Describe the activities contemplated to be undertaken within the plan area with sufficient detail to allow DLNR to evaluate the impact of the activities on the particular ecosystems, natural communities, or habitat types within the plan area that are the focus of the plan;
- Identify the steps that will be taken to minimize and mitigate all negative impacts, including without limitation the impact of any authorized incidental take, with consideration of the full range of the species on the island so that cumulative impacts associated with the take can be adequately assessed; and the funding that will be available to implement those steps;

- Identify the measures or actions to be undertaken; a schedule for implementation of the measures or actions; and an adequate funding source to ensure that the actions or measures are undertaken in accordance with the schedule;
- Be consistent with the goals and objectives of any approved recovery plan for any endangered species or threatened species known or reasonably expected to occur in the ecosystems, natural communities, or habitat types in the plan area;
- Provide reasonable certainty that the ecosystems, natural communities, or habitat types will be maintained in the plan area, throughout the life of the plan;
- Contain objective, measurable goals; time frames within which the goals are to be achieved; provisions for monitoring; and provisions for evaluating progress in achieving the goals quantitatively and qualitatively; and
- Provide for an adaptive management strategy that specifies the actions to be taken periodically if the plan is not achieving its goals.

Section 195D-25 provides for the creation of the ESRC, which is composed of biological experts, representatives of relevant federal and State agencies (i.e., USFWS, USGS, DLNR), and appropriate governmental and non-governmental members to serve as a consultant to the DLNR and the BLNR on matters relating to endangered, threatened, proposed, and candidate species.

Duties of the ESRC include reviewing all applications for HCPs, Safe Harbor Agreements, and ITLs, and making recommendations to the DLNR and the BLNR on whether they should be approved, amended or rejected; reviewing all existing HCPs, Safe Harbor Agreements and ITLs annually to ensure compliance, and making recommendations for any necessary changes; and considering and recommending appropriate incentives to encourage landowners to voluntarily engage in efforts that restore and conserve endangered, threatened, proposed, and candidate species. Hence, the ESRC plays a significant role in the HCP planning process. The Applicant has met with the ESRC several times during the preparation of this HCP.

1.3.6 State Environmental Review: Chapter 343, Hawai'i Revised Statutes

The approval of an HCP and issuance of an ITL under Chapter 195D, Hawai'i Revised Statutes (HRS), do not by themselves trigger a requirement for environmental review pursuant to Chapter 343, HRS. However, the project area is located in a State Conservation District and on land that is owned by the State of Hawai'i; both of these are triggers for Chapter 343 review. KWP II LLC prepared an *Environmental Impact Statement Preparation Notice (EISP)*, which was released for public comment on February 8, 2008. It then prepared a Draft Environmental Impact Statement (DEIS), dated February 2, 2009 (Planning Solutions Inc., 2009a). Following the end of the 45-day public review period for the DEIS, its review of the comments and of additional wind data that became available following publication of the DEIS led KWP II to decide to make the site evaluated in the DEIS an alternate and to identify the site that is the subject of this HCP as its "Preferred Alternative". KWP II LLC submitted a *Revised Draft Environmental Impact Statement (Revised DEIS)* in November 2009, which will be published and released for a 45-day public comment period (Planning Solutions Inc, 2009b). KWP II LLC will incorporate comments on the *Revised DEIS* into a *Final Environmental Impact Statement (FEIS)*, which will be submitted to the DLNR for review and acceptance. The FEIS acceptance will complete the State environmental review process for the project.

1.4 PROJECT DESCRIPTION

1.4.1 Project Design and Components

KWP II consists of a new 21-MW wind power generating facility and related facilities at Kaheawa Pastures above Mā'alaea, Maui, Hawai'i. The proposed project area is located on approximately 143 acres (58 ha) of State land southeast of the existing KWP facility at Kaheawa Pastures along the existing access road (see Figures 1.1 and 1.2).

Once all required land use approvals and environmental permits are granted, the Applicant will:

- Construct new internal service roads that connect the facility to the existing KWP access road;
- Install 14 General Electric (GE) 1.5-MW WTGs and supporting equipment. Each WTG will be set in a concrete foundation that is no more than 40 feet (12 m) by 40 feet in lateral directions. An additional 20-foot (6-m) wide cleared gravel perimeter will be provided around each foundation to facilitate access and maintenance. Table 1.3 lists other pertinent characteristics of the selected WTGs;
- Install an underground electrical collection network connecting all of the turbines, including excavation and burying of all wires and re-vegetation of the disturbed areas; a 1225 foot (374 m) overhead collection line mounted on poles approximately 60 - 90 feet (18 - 25 m) above ground level will be required for crossing Manawainui Gulch.
- Construct a new electrical substation and install underground electrical power lines connecting the turbines with the new substation;
- Install interconnection facilities to connect the project to the existing MECO power transmission system;
- Construct a Battery Energy Storage System (BESS) adjacent to the substation to provide dispatchable energy under various operating conditions. This stored energy will be used to improve the ability of the MECO system to absorb additional as-available wind-generated resources;
- Construct a maintenance building to house operations personnel, equipment and facility spare parts;
- As KWP II will not directly connect to Maui's municipal water supply, KWP II LLC is considering installing a 60,000-gallon tank adjacent to the existing O&M building at KWP. This water would be used for non-potable bathroom plumbing, dust control, irrigating re-introduced native plants, and emergency fire fighting. KWP II LLC estimates that daily water usage from the tank during normal operation will amount to about 250-450 gallons. If KWP II LLC does not install the tank, the proposed project would use bottled water and portable pumped toilets similar to the KWP I facility (Planning Solutions, Inc. 2009b); Potable water will be purchased and trucked up to the project area.
- Dismantle the four existing temporary met test towers, and construct one permanent unguyed met tower, a communications tower to support data gathering and control functions, and a temporary 213-foot (65-m) test tower prior to construction of the WTGs. The latter will be dismantled following erection of the turbines.

Figure 1.3 provides a conceptual site plan showing the proposed locations of the above-mentioned facilities. Access to the site would be from Honoapi'ilani Highway (State Highway 30) via an existing State-owned road that was improved during construction of the KWP facility. Construction of the proposed facilities would disturb approximately 43 acres (17.4 ha) of land (i.e., approximately 30% of the leased area, Table 1.2); the remainder would remain undisturbed. The total "developed" area of the site, or the total area that would contain structures, hardened surfaces or roads is anticipated to be 39.2 acres (15.9 ha). The *Revised DEIS* for the project

contains a detailed technical description of the infrastructure proposed for the project (Planning Solutions, Inc. 2009b.). The above areas will be refined through the final design process, subject to the approval of the Hawaii BLNR during the CDUP process.

Table 1.3 Characteristics of 1.5-MW Wind Turbine Generators

Power Generation	1.5 MW each
Tower Structure and Height	Tubular; 213 ft (65 m) tall
Rotor Diameter	231 ft (70 m)
Total Height (Tower + ½ Rotor)	328 ft (100 m)
Rotor Swept Area	50,130 ft ² (4,657 m ²)
Rotor Speed	10-21 rpm (variable)
Wind Speed at Which Generator Starts	8 mph (13 kph)
Wind Speed at Which Generator Cuts Out	56 mph (90 kph)
Rated Wind Speed (Unit Reaches Maximum Output)	27 mph (43 kph)
Note: Based on GE Model 1.5se on 64.7 m tower.	
Source: Kaheawa Wind Power LLC (2004).	

Table 1.4 Area Occupied Project Components

Project Component	Approximate Area Disturbed
	Alternative 1
14 WTG Foundations & Pads ¹	21 ac
Trenching for Underground Electrical Cables ²	2 ac
Permanent Meteorological Tower ³	0.2 ac
Maintenance Building, Substation, BESS	2 ac
Access Roads ⁴	16 ac
Temporary Lay-Down Area ⁵	2 ac
TOTAL	43 ac
⁽¹⁾ Each foundation occupies 2,500 ft ² ; total disturbed area is 1.5 acres per turbine. ⁽²⁾ Trenches will be 2.0 ft (0.6 m) wide and 4.0 ft (1.2 m) deep and backfilled to finish grade. ⁽³⁾ The Proposed Action includes one met tower, while Alternative 2 proposes two met towers. ⁽⁴⁾ Estimate based on 36-ft wide (11-m) strip of "disturbance." ⁽⁵⁾ One construction lay-down area for equipment staging roughly 150 ft x 250 ft (46 x 76 m).	
Source: Planning Solutions, Inc. (2009b).	

To minimize the risk of attracting seabirds to the facility in accordance with the guidelines discussed in Section 4.3, lighting would be kept to the minimum necessary for safety and operations. Lighting at the project would include that which is required by the Federal Aviation Administration (FAA) for aircraft safety. In March 2005, the existing KWP facility received FAA approval of lighting only six wind turbines (at intervals of 2,500 to 3,000 feet or 762 to 915 m) with medium intensity, simultaneously flashing red lights, utilizing the minimum flash frequency. KWP II LLC anticipates applying for a similarly reduced lighting plan for the KWP II project.

Other lighting would be provided at the operations and maintenance facility and substation for the purpose of illuminating the ground area, solely when work would need to be performed beyond daylight hours. Such lighting would consist of halogen flood lights that are shielded and/or directed downward. Lights would be turned on infrequently, and strictly as necessary, on the rare

occasions when personnel are working at the site during darkness. Inside lights at the maintenance and operations buildings would likewise be turned off at the end of each work day.

Personnel would generally be present at the facility on a daily basis throughout project operation. They would monitor the condition of the roadways and ensure that any needed maintenance is performed promptly, as well as ensure that the turbines and supporting facilities are operating properly. Site maintenance would include vegetation control (manual and chemical) on the turbine pads to prevent new growth that may otherwise attract nēnē, as well as revegetation in other disturbed areas using species commonly found in the general project area. Additional maintenance and site work may be conducted for fire prevention purposes at the direction of DLNR forestry officials, although any such work would first be reviewed and approved by USFWS and DLNR wildlife officials to ensure that it would not be expected to have any adverse impacts on any listed species.

The electrical power generated by KWP II would be purchased by MECO via a Power Purchase Agreement (PPA) reviewed and approved by the State of Hawai'i Public Utilities Commission (PUC). Power generated by the facility would be delivered from the proposed substation to the existing MECO 69kV (kilovolt) transmission line that passes directly through the southern end of the project area.

KWP II will implement a fire contingency plan as outlined in detail in the *Draft Revised EIS* for the project (Planning Solutions, Inc., 2009b.) that closely follows the fire contingency plan developed for KWP (Fire Contingency Plan for CDUA MA-3103, 2005).

1.4.2 Purpose and Need for KWP II Project

Maui presently depends heavily upon fossil fuels for its electrical energy needs. The purpose of the proposed KWP II project is to reduce that dependency by providing an alternative source that is renewable. As currently proposed, the project would provide an estimated 70,000 MWh-years of electricity per year (MWh/year) to MECO's system.¹ That is equivalent to well over 5% of the electricity produced on the island in 2007 or enough electricity to power about 7,700 average Maui homes (at 750 kilowatt-hours per month). By substituting a "local renewable" fuel source for imported fossil fuel, the project will help the State move toward its goal of energy independence and sustainability. Based on the best available projections of the cost of fossil fuel, it could also provide electricity to Maui's residents at a lower cost than would be possible using fossil fuel.

KWP II LLC estimates that the 21 MW of power that the proposed project would provide could reduce fossil fuel consumption by an estimated 138,000 barrels of fuel oil per year, significantly lowering Maui's dependence on imported fossil fuels.² Fossil fuel pricing has historically been volatile; fuel prices are subject to fluctuation based on supply and demand conditions as well as political concerns that can affect the long term availability of world supply.

Based on an average cost of oil at \$80/barrel over the life of the project, the Applicant estimates that the substitution of wind energy for fossil fuel energy would reduce the amount that MECO spends on imported fuel by approximately \$100,000,000. Reducing the proportion of its energy that comes from fossil fuel would also buffer the system from the energy cost fluctuations that accompany volatile oil prices.

Reducing the consumption of fossil fuel for energy generation by the estimated amount (138,000 barrels per year) would also benefit the environment in a number of ways. The most important of these is by reducing air pollutant emissions associated with the combustion of fossil fuels. Additional emission reductions will stem from the elimination of the need to transport petroleum fuels from distant ports to the island. These reductions in fossil fuel consumption would result in the following environmental benefits:

¹ This conservatively assumes that the turbines operate at an average of 40% capacity over the course of a year. The actual number of megawatt-hours per year (MWh/year) is expected to be somewhat higher than this.

² This estimate is based on the following: (a) Net capacity factor = 38%; (b) average heat rate for MECO-owned generation = 11,500 BTU/Net kWh; (c) BTU Savings = 803,905-1,148,436 MMBTU/yr; (d) 5.825 MMBTU/BBL of distillate (diesel) fuel oil; and 21 MW installed capacity.

- Avoidance of approximately 107 million pounds (48.5 million kg) of carbon dioxide (CO₂) annually emitted into the atmosphere.
- Elimination of approximately 0.75 million pounds (0.34 million kg) of sulfur dioxide (SO₂) annually emitted into the atmosphere.
- Elimination of approximately 195,000 pounds (88,450 kg) of nitrogen oxides (NO_x) annually emitted into the atmosphere.

These gases are known to contribute to various undesirable environmental effects including global warming and acid rain. Additionally it has been shown that these gases are detrimental to human health and the health of other living organisms. In general, the elimination of these harmful pollutants should result in reduced health costs and respiratory illnesses.

1.4.3 Project Schedule and Timeline

Construction of the access roads and turbine foundations is anticipated to begin shortly after permit issuance. Construction of the project would likely occur as soon as practicable after all permits and authorizations have been obtained, and financing is completed. The turbines will become operational approximately six to nine months after the start of construction.

The life of the project is anticipated to be 20 years, after which time the Applicant would arrange either to extend the life of the project or remove the facilities. The continuance of the project's operation would be subject to a renewal of KWP II LLC's lease with DLNR, as well as an extension of the term of this HCP, as it may be amended. Should KWP II LLC discontinue the operation of KWP II during or after this 20-year period, the lease terms will require that the turbines and other structures be removed and the site remediated and stabilized.

1.4.4 List of Preparers

This HCP was prepared by Ling Ong, Ph.D., Paul Sunby, B.S., Ryan Taira, B.A., John Ford, M.S., Shahin Ansari, Ph.D, and Tiffany Thair, B.A. of SWCA Environmental Consultants and Perry White, MRP, Melissa White, M.A., Julia Ham Tashima and Makena White of Planning Solutions, Inc. Contributors on behalf of Kaheawa Wind Power II, LLC include Dave Cowan, Greg Spencer and Robert Roy of First Wind Energy, LLC. Comments and guidance provided by Dr. Paula Hartzell and Dr. Scott Fretz of the Division of Forestry and Wildlife (DOFAW), James Kwon of USFWS, as well as members of the ESRC is gratefully acknowledged.

2.0 DESCRIPTION OF THE HABITAT CONSERVATION PLAN

2.1 PURPOSE OF THIS HCP

The construction and operation of the KWP II wind energy generation facility could adversely impact four species protected under the ESA and HRS Chapter 195-D, and other federal and State laws and regulations. These species are the federally and State-listed endangered Hawaiian petrel, the threatened Newell's shearwater, the endangered nēnē or Hawaiian goose, and the endangered Hawaiian hoary bat ("Covered Species"). These species have the potential to collide with the stationary WTGs and other facilities, or be struck by the moving WTG rotors, resulting in injury or mortality. These species also may collide with the temporary and permanent met towers, the guy wires supporting the temporary met towers and overhead collection lines; they could also be struck by vehicles and construction equipment during construction and operation.

The Hawaiian petrel ('ua'u) and the Newell's shearwater ('a'o) are endangered tropical Pacific seabirds that are endemic to, and nest only in the Hawaiian islands (American Ornithologists' Union 1998). The nēnē or Hawaiian goose is the rarest species of goose and is endemic to Hawai'i. The Hawaiian hoary bat ('ope'ape'a) is an endangered mammal unique to Hawai'i. These species are protected because of on-going threats to their survival. For the seabirds, threats are posed mainly by predation by introduced mammals and human-created hazards; for the goose and bat, threats largely stem from loss of habitat.

Pursuant to ESA Section 10(a)(1)(B), as amended, and HRS Chapter 195-D, an HCP is required to accompany application to the USFWS for an ITP and the State of Hawai'i for an ITL. Upon issuance of the ITP and ITL, KWP II LLC will be authorized for the incidental take of the Covered Species in connection with the construction and operation of the proposed wind energy generation facility. The purpose of this HCP is to make supportable determinations as to the potential impact that the wind energy generation facility could have on each of the Covered Species; to discuss alternatives to the proposed facility and its design in terms of these impacts; to propose appropriate efforts to minimize, mitigate, and monitor these potential impacts to the maximum extent practicable; to ensure funding for the completion of these efforts; and to provide for adaptive management and adjustment of the above measures as determined necessary during this HCP's implementation.

KWP II LLC is proud to play a role in increasing Maui's renewable energy portfolio and in reducing the island's dependence on imported fossil fuels. Through the successful implementation of this HCP, and in keeping with the project's other environmental benefits, the Applicant proposes to offset any impacts to the Covered Species and provide a net conservation benefit to these four species.

2.2 SCOPE AND TERM

This HCP seeks to offset the potential impact of the proposed wind energy generation facility on the Covered Species with measures that protect and perpetuate these species island-wide and statewide. The Applicant anticipates a 20-year project life, throughout which this HCP would be in effect. With monitoring and review by the USFWS and DLNR, the provisions for adaptive management will allow mitigation of project impacts to be adjusted appropriately. Accordingly, this HCP includes provisions for post-construction monitoring and adaptive management to allow flexibility and responsiveness to new information over the life of the project. Monitoring and adaptive management will be coordinated with USFWS and DLNR, as further detailed in Chapter 7 - Implementation.

2.3 SURVEYS AND RESOURCES

The following sources were used in the preparation of this HCP:

- General information on the site's physical environmental setting was summarized from the "*Kaheawa Wind Power II Revised Draft Environmental Impact Statement*" (*Revised DEIS*. Planning Solutions Inc., 2009b). Additional general information on the project

and site was obtained from the HCP and environmental assessment documents previously prepared for the KWP facility. Information on endangered species occurrence in the project area and documented take at the KWP facility was obtained from various site-specific studies conducted prior to and since the KWP facility commenced operation. These sources include:

- Studies completed in support of the KWP HCP; and
- Annual reports documenting compliance with the HCP and status of ongoing take monitoring, research, and mitigation at the KWP facility.
- An invertebrate survey of the project area that Mike Severns conducted in September 2009 (Appendix 9) to investigate the status of protected Hawaiian snails (*Achatinella spp.*) and other native invertebrates in the project area.
- Botanical survey of the proposed KWP II project area that Robert Hobdy conducted August 2009 and January 2010 (Appendix 7 and 15). The reports confirm that no rare, threatened, or endangered flora occurs in the project area.
- A archaeological inventory survey and cultural impact assessment of the proposed KWP II lease area prepared by Rechtman Consulting LLC (Rechtman et al. 2009). The two reports demonstrate project compliance with the NHPA and document the fact that no historic, archaeological, or cultural resources are expected to be adversely impacted by the project. Details are provided in the *Revised DEIS* (Planning Solutions Inc., 2009b)
- ABR Inc. reports documenting passage rates and modeling collision probabilities to estimate rates of take for the KWP II facility (Summer and Fall 2009, Appendix 3, 13).

In addition to site-specific surveys, staff from KWP, USFWS, and DLNR provided unpublished information, data, and reports to ensure that all available resources could be considered and evaluated in the preparation of this HCP. Continued coordination with USFWS and DLNR biologists and KWP staff also greatly contributed to the preparation of this HCP.

3.0 ENVIRONMENTAL SETTING

This chapter provides an overview of the existing environment in the KWP II project area. The discussion pays special attention to the aspects of the environment that may be directly affected by construction and operation of the proposed wind energy generation facility. The physical and biological setting of the project is described in detail in the *Draft Revised DEIS* for the project (Planning Solutions, Inc., 2009b.).

3.1 LOCATION AND VICINITY

The proposed KWP II project is located on the southwestern slopes of the West Maui Mountains. The lowest of the proposed WTGs is approximately 0.8 miles inland from Honoapi'ilani Highway along the existing access road; the uppermost is approximately 2.1 road-miles inland. The settlements nearest the proposed KWP II project area are Olowalu, which is over five miles (8 km) to the southwest, and Mā'alaea, which is approximately 1.5 miles (2.4 km) to the east of the nearest WTG (both are straight-line distances).

3.2 LAND USE DESIGNATION

The proposed KWP II project area is in the General subzone of the State Conservation District as established and regulated by Chapter 205, Hawai'i Revised Statutes. Lands within the Conservation District are typically utilized for protecting watershed areas, preserving scenic and historic resources, and providing forest, park and beach reserves [subsection 205-2(e) HRS]. The entire project area is owned by the State of Hawai'i. As with other Conservation District lands, the two parcels on which project-related work would be done are not subject to any County of Maui zoning or community plan designations or restrictions.

3.3 TOPOGRAPHY AND GEOLOGY

The proposed WTGs would be constructed on the lower part of a broad interfluvial between Manawainui Gulch on the west and Malalowaia'ole Gulch on the east. The proposed baseyard (substation, battery energy storage system and support facilities) would be constructed in Kaheawa Pastures adjacent to the upper electrical transmission corridor. Kealaloloa Ridge, another broad interfluvial lies immediately northeast of Malalowaia'ole Gulch and separates the proposed facilities from the isthmus of Maui to the east. The gulches are steep and rocky. Several small pu'u are present in the area, including Pu'u Lū'au, which is near the uppermost of the two existing MECO transmission line corridors at an elevation of about 2,300 feet (701 m) above mean sea level (msl).

The ground slope along the length (i.e., the mauka-makai axis) of the area where the WTGs would be constructed varies, but averages about 14%. The WTGs and other facilities would be constructed on an interfluvial with cross-slopes that are variable, but typically are no more than 2 to 3%.

The project area lies on the flank of the extinct West Maui volcano, which evolved through shield (1.6 to 2.0 million years ago), post-shield (1.2-1.5 million years ago), and rejuvenated stages. While each of the flows was relatively thin, the accumulation during each stage was thousands of feet thick. Nearly a half-million years passed between the post-shield and rejuvenated phases with no evidence of volcanic activity. The rejuvenated-stage eruptions involved several small cones and ended about 385,000 years ago. The oldest of the small cones is Kīlea, which lies a short distance inland from Olowalu on the southwest side of West Maui. The youngest cone, Pu'uhele, lies approximately 1.6 miles (2.5 km) north of Mā'alaea along the road to Wailuku. There are no known unique or unusual geologic resources or conditions in the area.

3.4 SOILS

Soils in the area where the proposed WTGs would be constructed are exclusively characterized as rock lands (rRK) by the National Resource Conservation Service (Foote et al, 1972). This substrate consists of thin soils formed from gray trachyte lavas of the Honolulu Series which overlay the foundational lavas of the West Maui volcano. These lavas weather to platy gray blocks that extend across the entire ridge. Kaheawa Pastures, where the new baseyard would be constructed, is mostly underlain by deep, well-drained volcanic soils that transition into the steep, rocky gulches to the east, south, and west of the project area. [Table 3.1](#) lists the characteristics of the major soil types that occur in the proposed KWP II project area.

Table 3.1 Characteristics of Soil Types within the Project Area

Soil Type	Slope (%)	Permeability	Runoff	Erosion Hazard	Land Uses
Nā'iwa silty clay loam	3-20	Moderately Rapid	Medium	Moderate to Severe	Pasture, woodland, & wildlife habitat
Oli silt loam	3-10	Rapid	Medium	Moderate	Pasture and wildlife habitat
Rock land	-	-	-	-	Pasture, wildlife habitat, water supply, urban development
Source: General Soil Survey of Hawai'i, Foote et al. 1972 (U.S. Soil Conservation Service).					

3.5 HYDROLOGY AND WATER RESOURCES

Average annual rainfall in the general project area ranges from less than 15 inches (38 cm) per year at the Honoapi'ilani Highway/site access road intersection to slightly over 40 inches (102 cm) per year at the uppermost of the existing KWP WTGs. The area where the proposed WTGs would be constructed is quite arid with annual rainfall totaling only about 12 to 20 inches per year (Armstrong, 1983). Most of the rainfall occurs during winter months (>80% from November through April).

The land on which the proposed WTGs would be developed consists of rocky ridges; the proposed KWP II baseyard is on grasslands near the middle of the existing KWP I wind farm. There are no wetlands or other aquatic habitats (Hobdy 2004a, 2004b, 2006, and 2009). No perennial streams flow through the area, though storm runoff is present in Malalowaiaole Gulch just to the east of the proposed WTGs during rainy periods. On-site drainage is in a southeasterly direction toward Malalowaiaole Gulch and the Pacific Ocean.

The State of Hawai'i Commission on Water Resource Management (Letter from CWRM to Perry White, dated March 14, 2008) has determined that Manawainui Gulch does not have sufficient water to support instream uses. It therefore is not considered a stream and is not subject to CWRM regulation. The U. S. Army Corps of Engineers (USACE) concluded that the KWP project (including the access road along which the proposed WTGs are located) is entirely within an upland area and does not contain or convey waters of the U.S. subject to authorization by USACE permit (Young, November 8, 2004).

The project area is located over the Ukumehame Sector of the Lahaina Aquifer (Aquifer Code 60206 as designated by the State of Hawai'i Water Use Commission). The estimated depth to basal groundwater varies throughout the project area and is likely to be approximately 1,500 to 2,500 feet (457 to 762 m) below the surface. Groundwater likely flows in a southerly direction. Perched groundwater may also underlie the project area (VEC 2005). The KWP II project area is located mauka of the Underground Injection Control (UIC) line, which is the designated boundary that divides protected inland areas situated over drinking water sources from seaward areas located over non-potable groundwater.

3.6 TERRESTRIAL FLORA

In pre-contact times the area on which the proposed facilities would be constructed is believed to have been entirely covered with native vegetation of low stature, with dry grass and shrublands below and mesic to wet windblown forests above. Native Hawaiians made some uses of forest resources here and had a cross-island trail cresting the ridge at 1,600 feet elevation (Hobdy 2006a). This trail was upgraded during the mid-1800s and used as a horse trail to Lahaina. It was reopened in recent years and is the present Lahaina Pali Trail (Hobdy 2006a).

Cattle ranching in the area began in the late 1800s and continued for over 100 years. During this time, grazing animals consumed most of the native vegetation, which was gradually replaced by hardy non-native weed species. During the 1950s, MECO installed high voltage transmission lines and maintenance roads through this area. Increased traffic brought more disturbances and weeds (Hobdy 2006a). Fires became more frequent, further eliminating remnant native vegetation (Hobdy 2006a). Grass and weed species have proliferated since cattle grazing ceased, creating a heightened fire hazard. A large fire swept across the mountain in 1999 consuming more than 2,500 acres (1,012 ha) including most of the project area. Another fire burned the same area in September 2006, scorching about 75% of the project area and affecting nearly 4,000 acres (1,619 ha) of rangeland in the adjacent region.

In 2009, Hobdy (2009) identified 62 plant species, 15 of which are native to the Hawaiian Islands. During the supplemental 2010 survey, a total of 57 species were identified. This survey documented 16 native species, nine of which were not recorded during the 2009 survey. Thus, the entire KWPII area contains 24 plants native to the Hawaiian Islands; fifteen of these are endemic and nine are indigenous (Appendix 9 and 15, Table 3.2). No state or federally listed threatened, endangered, or candidate plant species were found during either survey (Hobdy 2009, 2010).

The vegetation in the KWPII area is mostly grasses and low-growing shrubs, with occasional small trees in the wetter gullies. The most abundant species in the project area is buffelgrass (*Cenchrus ciliaris*), which proliferated after the fires in 1999. Other common species in the vicinity of the proposed WTGs are natal redtop (*Melinis repens*), 'ilima (*Sida fallax*), 'uhaloa (*Waltheria indica*), lesser snapdragon (*Antirrhinum orontium*), and Jamaican vervain (*Stachytarpheta jamaicensis*). In the two small areas of the existing KWP I area proposed to be developed under Alternative 1 and within the proposed trenching corridor, the most common species include molasses grass (*Melinis minutiflora*), 'ūlei (*Osteomeles anthyllidifolia*), lantana (*Lantana camara*), natal redtop, and 'a'ali'i.

Of the 26 native plant species documented on-site, eight are endemic and seven are indigenous to the Hawaiian Islands (Table 3.2). The botanical surveys indicate that native plant species are most prevalent in the rocky habitat bordering Manawainui and Malalowaia'ole Gulches (Hobdy 2009). These habitats are the most protected from grazing and fire. The three hardiest species 'ilima, 'uhaloa and 'a'ali'i are also present on the flatter grassy ridge tops. Native vegetation is less prevalent at the lower, drier parts of the area where fires have more recently occurred (Hobdy 2009b). Most of these native plants are common at Kaheawa and throughout the main Hawaiian Islands. Only one species found within Alternative 1, *Bidens micrantha*, is found only on Maui and Lana'i, but is common in West Maui (Hobdy 2010).

Table 3.2 Native Hawaiian Plants Observed in the KWP II Project Area by Hobby (2009)

Scientific Name	Common Name	Status ¹	Abundance (at site) ²
FERNS			
<u>DENNSTAEDTIACEAE</u> (Bracken Family)			
<i>Pteridium aquilinum</i> (L.) Kuhn var. <i>decompositum</i> (Gaud.) R.M. Tryon	kilau	E	rare
<u>PTERIDACEAE</u> (Brake Fern Family)			
<i>Doryopteris decipiens</i> (Hook.) J.Sm.	kumuniu	E	rare
MONOCOTS			
<u>CYPERACEAE</u> (Sedge Family)			
<i>Carex wahuensis</i> C.A. Meyen subsp. <i>wahuensis</i>	-----	E	uncommon
<i>Cyperus phleoides</i> Nees ex Kunth subsp. <i>phleoides</i>	-----	E	rare
<u>POACEAE</u> (Grass Family)			
<i>Eragrostis deflexa</i> Hitchc.	kalamalō	E	rare
<i>Heteropogon contortus</i> (L.) P. Beauv. ex Roem. & Schult.	pili	I	uncommon
<i>Trisetum inaequale</i> Whitney	-----	E	--
DICOTS			
<u>AMARANTHACEAE</u> (Amaranth Family)			
<i>Chenopodium oahuense</i> (Meyen) Aellen	‘āheahea	E	rare
<u>ASTERACEAE</u> (Sun Flower Family)			
<i>Bidens micrantha</i> subsp. <i>micrantha</i> Gaud.	ko’oko’olau	E	uncommon
<i>Lipochaeta lobata</i> (Gaud.) DC. var. <i>lobata</i>	nehe	E	rare
<i>Melanthera lamarum</i> (Gaud.) Wagner & Rob.	nehe	E	uncommon
<u>CONVOLVULACEAE</u> (Morning Glory Family)			
<i>Ipomoea indica</i> (J. Burm.) Merr.	koali awahia	I	rare
<u>ERICACEAE</u> (Heath Family)			
<i>Leptecophylla tameiameia</i> (Cham. & Schlect.) C.M. Weiller	pūkiawe	I	uncommon
<u>EUPHORBIACEAE</u> (Spurge Family)			
<i>Chamaesyce celastroides</i> (Boiss.) Croizat & Degener var. <i>amplectens</i> (Sherff) Degener & I. Degener	‘akoko	E	uncommon

Scientific Name	Common Name	Status ¹	Abundance (at site) ²
<u>GOODENIACEAE</u> (Goodenia Family)			
<i>Scaevola gaudichaudii</i> Hooker & Arnott	naupaka kuahiwi	E	rare
<u>MALVACEAE</u> (Mallow Family)			
<i>Sida fallax</i> Walp.	`ilima	I	common
<u>MENISPERMACEAE</u> (Moonseed Family)			
<i>Cocculus orbiculatus</i> (L.) DC.	huehue	I	rare
<u>MYOPORACEAE</u> (Myoporum Family)			
<i>Myoporum sandwicense</i> A. Gray	naio	I	rare
<u>MYRTACEAE</u> (Myrtle Family)			
<i>Metrosideros polymorpha</i> Gaud. var. <i>glaberrima</i> (H.Lev.) St. John	`ohia	E	uncommon
<i>Metrosideros polymorpha</i> Gaud. var. <i>incana</i> (H. Lev.) St. John	`ohia	E	rare
<u>PAPAVERACEAE</u> (Poppy Family)			
<i>Argemone glauca</i> (Nutt. ex Prain) Pope	puakala	E	rare
<u>ROSACEAE</u> (Rose Family)			
<i>Osteomeles anthyllidifolia</i> (Sm.) Lindl.	`ūlei	I	uncommon
<u>SANTALACEAE</u> (Sandalwood Family)			
<i>Santalum ellipticum</i> Gaud.	`iliahialo'e	E	rare
<u>SAPINDACEAE</u> (Soapberry Family)			
<i>Dodonaea viscosa</i> Jacq.	`a'ali'i	I	uncommon
<u>STERCULIACEAE</u> (Cacao Family)			
<i>Waltheria indica</i> L.	`uhaloa	I	common
<u>THYMELAEACEAE</u> (`Akia Family)			
<i>Wikstroemia oahuensis</i> (A.Gray) Rock.	`akia	E	rare
⁽¹⁾ E= endemic (native only Hawai'i); I= indigenous (native to Hawai'i and elsewhere).			
⁽²⁾ Common= widely scattered throughout or locally abundant; uncommon= scattered sparsely throughout or occurring in a few small patches; rare= only a few isolated individuals.			
Source: Hodby 2009a, 2010.			

3.6.1. Plant Sanctuaries, Critical Habitats and Plants of Interest in the Vicinity of KWP II

Though no federally-listed plant species, plant species of concern, and/ or rare Hawaiian plants have been recorded on the KWP II site, several have been documented upslope of the existing KWP facility, specifically within Manawainui Gulch, Pāpalaua Gulch, and Kealaloloa ridge (including the Manawainui Plant Sanctuary). The endangered species include *Remya mauiensis*, `iliahi (*Santalum freycinetianum* var. *lanaiense*), *Diellia erecta*, pauoa (*Ctenitis squamigera*), *Cystopteris douglasii*, *Cyanea obtuse*, ha'iwale (*Cyrtandra oxybapha*), *Schiedea pubescens*, ko'oko'olau (*Bidens campylotheca* subsp. *pentamera*) and koki'o `ula'ula (*Hibiscus kokio*) (Hobdy 2006b). All plant species with designated critical habitat are more than 1.6 mi (2.5 km) from the KWP II

property boundary and are not expected to be impacted by the project (Hobdy 2009). Many other native species occur within these two gulches, but are not rare enough to be protected by federal or state laws (Hobdy 2006b).

3.7 NON-LISTED WILDLIFE SPECIES

In addition to the Covered Species discussed in the following section, the mixed grassland / shrubland vegetation in the project area provides habitat to two endemic mollusks, endemic, indigenous, or migratory birds and several, mostly introduced, mammals.

No federally listed species of snails were found in a recent molluscan survey conducted at the KWP II area (Severns 2009, Appendix 9). One native species of snail was found, *Succinea mauiensis* (Family: Succinidae). *S. mauiensis* is found in dry habitat and has a wide range on Maui. At the proposed KWP II downroad site, specimens were found only on the undersides of undisturbed rock outcroppings or in the root mat of grasses beneath rocks. The species was uncommon in the pasture where most of the development activity is proposed, and more common at the upper edges of the gulches.

Succinea mauiensis is also likely to be present in similar habitats within Kaheawa Pastures; thus careful planning and caution during construction activity in the vicinity of the upper edges of the gulches should be sufficient to protect the species within the project area (Severns 2009). This species may also benefit and increase in numbers with the stabilization of the pasture and protection from fire as a result of the development of KWP II (Severns 2009). The species tentatively identified as *Nesopupa* in Appendix 9, has been confirmed as *Gastrocopta lyonsiana/servilis* which is a widespread Indo-Pacific species and therefore introduced (Severns pers comm.).

Thirteen bird species have been observed by KWP biologists for the KWP II area (Table 3.3). Two other introduced species documented by Nishibayashi (1997 and 1998) in the KWP area could also occur at the KWP II area. The two species are the northern cardinal (*Cardinalis cardinalis*) and the house finch (*Carpodacus mexicanus*). Two native or endemic species occur on site, the endangered nēnē (*Branta sandvicensis*) and the Hawaiian short-eared owl (*Asio flammeus sandwichensis*). The indigenous white-tailed tropic bird has been observed flying overhead (*Phaethon lepturus*) and one migratory species, the Pacific golden-plover (*Pluvialis fulva*), is present on-site during the migratory season (late August to May). All the native species and migratory species present at KWP II are also protected by the MBTA.

Cooper and Day (2009) reported nine observations of Hawaiian short-eared owls at the proposed project site during five nights of surveys in July 2009. Hawaiian short-eared owls are present year-round at Kaheawa Pastures and are observed regularly in the vicinity of KWP. Most owl activity is concentrated in the nearby gulches, although individuals also forage over the open, flatter parts of the KWP II area. One Hawaiian short-eared owl fatality associated with a turbine collision has been reported after nearly 4 years of operation. In the vicinity of turbines, most observations of Hawaiian short-eared owl have been below the rotor swept zone of the turbines and thus their susceptibility to collision appears to be low despite a regular presence in the area (Spencer, pers. comm.). One Hawaiian short-eared owl fatality was also found at the base of existing transmission lines not associated with KWP.

At Wolfe Island, Ontario, it was observed that short-eared owls were most vulnerable to colliding with turbine blades during predator avoidance and during aerial flight displays (Stantec Consulting Ltd. 2007). Short-eared owls on Maui have no aerial predators and thus may only be vulnerable to colliding with turbines during flight displays. Four total fatalities of short-eared owl (*Asio flammeus flammeus*) have been recorded at operating wind farms, one each at McBride Lake, Alberta, Canada, Foote Creek Rim, Wyoming, Nine Canyon, Wyoming, and Altamont Wind Resource Area, California (Kingsley and Whittam 2007).

White-tailed tropicbirds (*Phaethon lepturus*) are sometimes seen near the project area by KWP staff but usually remain associated with the deep gulches adjacent to the site. This species is known to nest in steep valley faces and canyon walls which are common features in nearby

Ukumehame, Manawainui, and Malalowaiole Gulches. One fatality attributable to a turbine collision has been observed at KWP to date.

Thus far, two ringed-necked pheasants, three black francolins, and two gray francolins have collided with the towers and one barn owl with a turbine rotor at KWP. In addition, two feather piles of Eurasian skylarks have been observed in the vicinity of KWP, though well outside of the search plots (i.e., at a distance of more than the height of the turbines) in the more than three years of project operation at KWP. The cause of death of the Eurasian skylarks is undetermined but because of the distance they are believed to be due to predation or other natural causes.

Based upon information provided by Maui DLNR staff and KWP biologists, mammals occurring in the vicinity of the project area likely to include the house mouse (*Mus musculus*), rats (*Rattus* sp.), axis deer (*Cervus axis*), small Indian mongoose (*Herpestes auropunctatus*), feral cat (*Felis silvestris*), and feral dog (*Canis lupus*), although no evidence of dogs has been documented in the project area since KWP began operations in June 2006 and only a few reports of deer have been received during the same period.

Table 3.3 Avian Species Identified in the Project Area by KWP Biologists (2006 to present)

Scientific Name	Common Name	Status (Protection)
<i>Branta sandvicensis</i>	Hawaiian goose, nēnē	E (MBTA, Endangered)
<i>Phaethon lepturus dorotheae</i>	White-tailed tropic bird	N (MBTA)
<i>Francolinus pondicerianus</i>	Gray francolin	I
<i>Francolinus francolinus</i>	Black francolin	I
<i>Phasianus colchicus</i>	Ring-necked pheasant	I
<i>Pluvialis fulva</i>	Pacific golden-plover	M (MBTA)
<i>Streptopelia chinensis</i>	Spotted dove	I
<i>Geopelia striata</i>	Zebra dove	I
<i>Asio flammeus sandwichensis</i>	Hawaiian short-eared owl	N (MBTA, state Endangered on Oahu)
<i>Tyto alba</i>	Barn owl	I (MBTA)
<i>Alauda arvensis</i>	Eurasian skylark	I (MBTA)
<i>Acridotheres tristis</i>	Common myna	I
<i>Lonchura punctulata</i>	Nutmeg mannikin	I

E = endemic, I = Introduced, M = migratory, N = native, MBTA = Migratory Bird Treaty Act

3.8 LISTED WILDLIFE SPECIES

To date, no portion of the project area has been designated as critical habitat for any listed species. Of the four Covered Species, the nēnē and Hawaiian hoary bat are the only two that likely use the habitats in the project area. Nēnē are known to be resident in the project area and acoustic bat detectors stationed in the KWP and KWP II project areas have recorded low levels of bat activity that may be seasonal. Hawaiian petrels and Newell's shearwaters nest in the West Maui Mountains; individuals of these species may occasionally fly through the airspace of the KWP II project area.

As at KWP, the proposed WTGs and met towers associated with the KWP II project would potentially present collision hazards to all four of the Covered Species. Lighting these structures pursuant to FAA regulations may increase the risk of avian collisions (Gehring and Kerlinger 2007). Table 3.4 lists the federally listed species with potential to be adversely impacted by operation of the KWP II project and for which federal and state authorization of incidental take is being sought. Information on each of these species is provided following Table 3.4

Table 3.4 Federally Listed Species with Potential to be Impacted by the KWP II Project (E = endangered, T = threatened).

Scientific Name	Common, Hawaiian Name(s)	Date Listed	Status
Birds			
<i>Puffinus auricularis newelli</i>	Newell's shearwater, 'a'o	10/28/1975	T
<i>Pterodroma sandwichensis</i>	Hawaiian petrel, ua'u	3/11/1967	E
<i>Branta sandvicensis</i>	Hawaiian goose, nēnē	3/11/1967	E
Mammals			
<i>Lasiurus cinereus semotus</i>	Hawaiian hoary bat, 'ope'ape'a	10/13/1970	E

3.8.1 Hawaiian Petrel

3.8.1.1 *Population, Biology and Distribution of the Hawaiian Petrel*

Hawaiian petrel was once abundant on all main Hawaiian islands except Ni'ihau (Mitchell et al. 2005). The population was most recently estimated to be approximately 20,000, with 4,000 to 5,000 breeding pairs (Mitchell et al. 2005). Today, Hawaiian petrels continue to breed in high-elevation colonies on Maui, Hawai'i, Kaua'i and Lāna'i (Richardson and Woodside 1954, Simons and Hodges 1998, Telfer et al. 1987, DOFAW unpublished data 2006, 2007). Radar studies conducted in 2002 also suggest that breeding may occur on Moloka'i (Day and Cooper 2002). Breeding is thought to no longer occur on O'ahu (Harrison 1990).

Survey work at a recently re-discovered Hawaiian petrel colony on Lana'i, that had been previously thought to be extirpated, indicates that thousands of birds are present, rather than hundreds of birds as first surmised, and that the size of the breeding colony approaches that at Haleakalā, Maui, where as many as 1,000 pairs have been thought to nest annually (Mitchell et al. 2005, Tetra Tech EC, Inc., June 2008). Radar counts of petrels on the perimeter of Maui and recent colony detections by KWP researchers suggest that the Maui population may be much higher than the 1,000 pairs previously estimated (Cooper and Day 2003).

Hawaiian petrels are nocturnal and subsist primarily on squid, fish, and crustaceans caught near the sea surface. Unlike shearwaters, Hawaiian petrels are not known to dive or swim below the surface (Pitman 1986). Foraging may take place thousands of kilometers from their home islands during both breeding and non-breeding seasons (Spear et al. 1995). In fact, recent studies conducted using satellites and transmitters attached to Hawaiian petrels have shown that they can range across more than 6,200 miles (10,000 km) during two-week foraging expeditions (Adams 2008).

Hawaiian petrels are active in their nesting colonies for about eight months each year. The birds are long-lived (ca. 30 years) and return to the same nesting burrows each year between March and April. Present-day Hawaiian petrel colonies are typically located at high elevations above 2,500 meters (8,200 ft). The types of habitats used for nesting are very diverse and range from xeric habitats with little or no vegetation, such as at Haleakala National Park on Maui, to wet forests dominated by 'ōhi'a with uluhe understory as those found on Kaua'i (Mitchell et al. 2005). Females lay only one egg per year, which is incubated alternately by both parents for approximately 55 days. Eggs hatch in June or July, after which both adults fly to sea to feed and return to feed the nestling. The fledged young depart for sea in October and November. Adult birds do not breed until age six and may not breed every year, but pre-breeding and non-breeding birds nevertheless return to the colony each year to socialize.

3.8.1.2 Current Threats to the Hawaiian Petrel

The most serious land-based threat to the species is predation of eggs and young in the breeding colonies by introduced mammalian predators such as small Indian mongoose, feral cats, owls, pigs, dogs, and rats. Population modeling by Simons (1984) suggested that this species could face extinction in a few decades if predation is not controlled. Intensive trapping and habitat protection has helped to improve nesting and fledging success (Ainley et al. 1997). Hodges and Nagata (2001) found that nesting activity (signs of burrow activity) in sites protected from predators on Haleakala ranged from 37.25 to 78.13% while nesting activity in unprotected sites ranged from 23.08 to 88.17%. Nesting success (proportion of active burrows that showed signs of fledging chicks) in protected sites ranged from 16.97 to 50.00%, while nesting success in unprotected sites ranges from 0.00 to 44.00% averaging 42.4% and 27.1% respectively (Table 6.2, Hodges and Nagata 2001).

Ungulates can indirectly affect nesting seabirds by overgrazing and trampling vegetation, as well as facilitating erosion. Climatic events such as El Niño can also impact the reproductive success of seabirds (Hodges and Nagata 2001). Other threats include occasional mortality from collisions with power lines, fences, and other structures near breeding sites or attraction to bright lights. In addition, juvenile birds are sometimes grounded when they become disoriented by lights on their nocturnal first flight from inland breeding sites to the ocean. A few, mostly juvenile, Hawaiian petrels have landed in brightly lit areas at scattered locations on Maui most years. The problem is much smaller than the one involving Newell's shearwaters (see following section), and Simons and Hodges (1998) conclude that it is probably not a threat to remaining populations.

One Hawaiian petrel fatality, presumed to have collided with a WTG, has been recorded at KWP since the beginning of operations in January 2006 (Kaheawa Wind Power, LLC 2008b, 2008c).

3.8.1.3 Occurrence of the Hawaiian Petrel on Maui

Simons and Hodges (1998), and recent observations of birds calling and performing aerial displays consistent with breeding behavior, indicate the presence of Hawaiian petrel nesting colonies in West Maui (Kaheawa Wind Power, LLC. 2007). Cooper and Day (2003) also observed Hawaiian petrels flying inland over the northern coast toward the mountainous interior of West Maui.

Research and field investigations in support of the KWP HCP confirmed the presence of at least one nesting colony of Hawaiian petrels in West Maui in the lower portion of Kahakuloa Valley and possibly another small colony in the West Maui Mountains in the upper portions of Kahakuloa and Honokōhau Valleys (G. Spencer, First Wind, pers. comm., see Figure 3.1). The colony finding near lower Kahakuloa Valley was corroborated by DLNR/DOFAW wildlife biologists from Maui and seabird researchers from the USGS and H.T. Harvey and Associates in early July 2007.

Mount Haleakalā, which defines East Maui supports the largest known nesting colony of Hawaiian Petrels (USFWS 2005b, Hodges and Nagata 2001). Approximately 1,000 known nests are within the crater of the dormant shield volcano, with the highest concentration on the western rim between 2,400 and 3,055 m elevation. The highest densities of nests (15-30 burrows per hectare) occur within Haleakalā National Park. Predator trapping is conducted year-round to reduce predation pressure on these burrows. Lower densities of nesting burrows occur elsewhere in the crater and beyond the park boundaries, but these are currently not actively managed (Hodges and Nagata 2001).

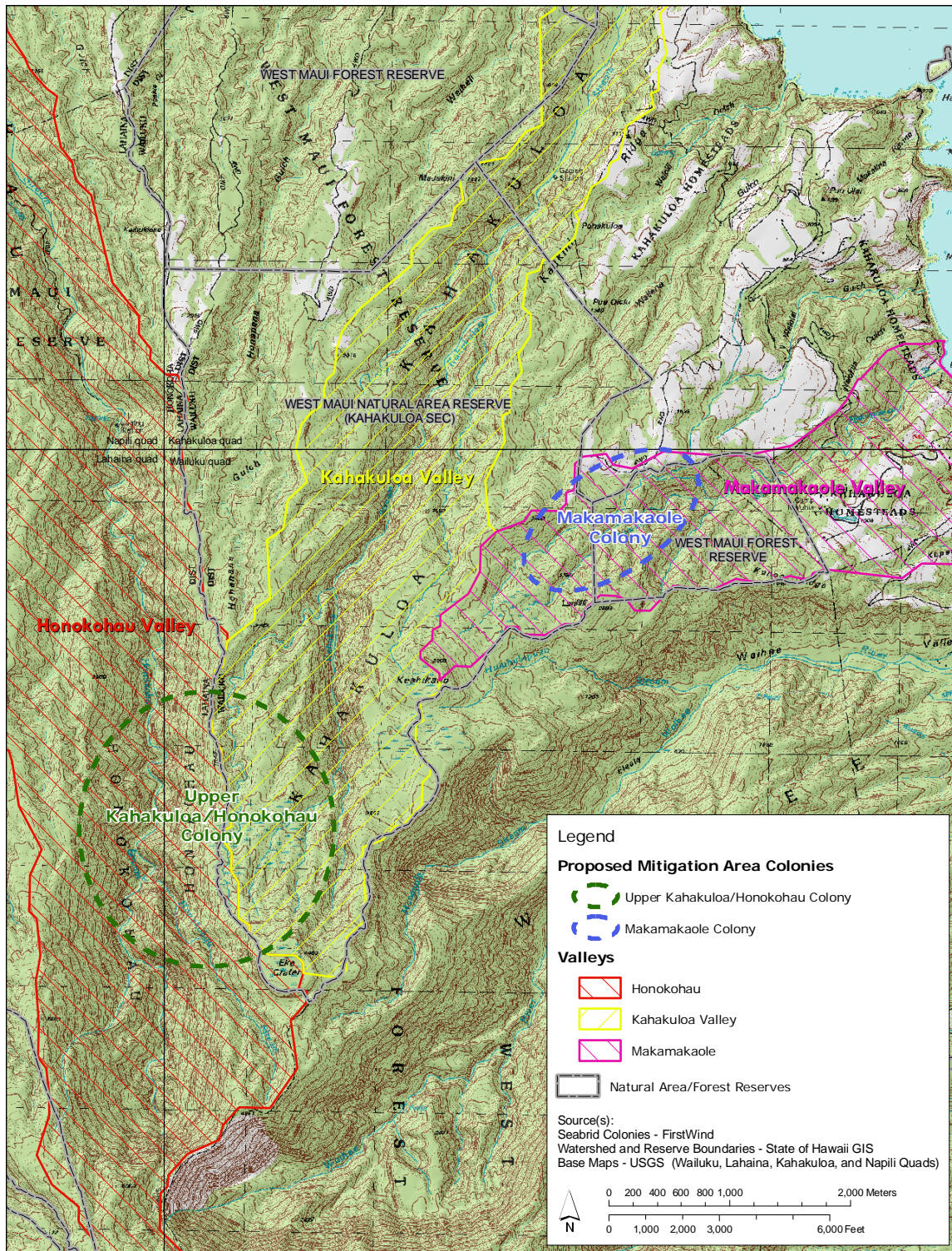


Figure 3.1. Seabird Colonies on West Maui

3.8.1.4 Occurrence of the Hawaiian Petrel in the Project Area

ABR Inc. conducted radar and night-visual observations in July and October 2009 to document passage rates of seabirds over KWP II during the nesting season. The estimated number of Hawaiian petrel passing through the airspace of KWP II is 6.3 birds/night for the spring/summer season and 4.12 birds/night during the Fall fledging season. Passage rates in the Fall are lower because the visitation rates by adults to feed their chicks decline as much as 80% in the last quarter of the nestling period (Simons 1985).

Spring/summer and Fall passage rates of seabirds (Hawaiian petrels and Newell's shearwaters combined) at KWP II are within the range of variability of passage rates observed upslope at KWP over the last ten years (Figure 3.2a). However, when comparing passage rates over other areas and islands of Hawaii, passage rates over the KWP and KWP II project area are lower than the mean rate measured for West Maui (8.7 ± 3.9 targets/hr Fig. 3.2a), East Maui (52.8 ± 16.6 targets/hr, Cooper and Day 2003, Figure 3.2b) and are less than 2.5 % of the mean passage rates measured on Kauai (131 ± 35 targets/hr, Day and Cooper 2001).

3.8.2 Newell's Shearwater

3.8.2.1 Population, Biology, and Distribution of the Newell's Shearwater

The Newell's shearwater is an endemic Hawaiian sub-species of the nominate species, Townsend's shearwater (*Puffinus a. auricularis*) of the eastern Pacific. The Newell's shearwater is considered "Highly Imperiled" in the Regional Seabird Conservation Plan (USFWS 2005b) and the North American Waterbird Conservation Plan (Kushlan et al. 2002). Species identified as "Highly Imperiled" have suffered significant population declines and have either low populations or some other high risk factor.

The most recent population estimate of Newell's shearwater was approximately 84,000 birds, with a possible range of 57,000 to 115,000 birds (Ainley et al. 1997). Radar studies on Kaua'i showed a 63% decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003a). The largest breeding population of Newell's shearwater occurs on Kaua'i (Telfer et al. 1987, Day and Cooper 1995, Ainley et al. 1995, 1997b, Day et al. 2003). Breeding also occurs on Hawai'i Island (Reynolds and Richotte 1997, Reynolds et al. 1997, Day et al. 2003a) and almost certainly occurs on Moloka'i (Pratt 1988, Day and Cooper 2002). Recent radar studies suggest the species may also nest on O'ahu (Day and Cooper 2008). On Maui, radar studies and visual and auditory surveys conducted over the past decade suggest that one or more small breeding colonies are present in the West Maui Mountains in the upper portions of Kahakuloa Valley (G. Spencer, First Wind, pers. comm. see Figure 3.1).

Newell's shearwaters typically nest on steep slopes vegetated by uluhe fern (*Dicranopteris linearis*) undergrowth and scattered 'ōhi'a (*Metrosideros polymorpha*) trees. Currently, most Newell's shearwater colonies are found from 525 to 3,900 feet (160 to 1,200 m) above mean sea level, often in isolated locations and/or on slopes greater than 65 degrees (Ainley et al. 1997). The birds nest in short burrows excavated into crumbly volcanic rock and ground, usually under dense vegetation and at the base of trees. A single egg is laid in the burrow and one adult bird incubates the egg while the second adult goes to sea to feed. Once the chick has hatched and is large enough to withstand the cool temperatures of the mountains, both parents go to sea and return irregularly to feed the chick. The closely related Manx shearwater is fed every 1.2-1.3 days (Ainley et al. 1997). Newell's shearwaters arrive at and leave their burrows during darkness and birds are seldom seen near land during daylight hours. During the day, adults remain either in their burrows or at sea some distance from land.

First breeding occurs at approximately six years of age, after which breeding pairs produce one egg in a given year. A high rate of non-breeding is found among experienced adults that occupy breeding colonies during the summer breeding season, similar to some other seabird species (Ainley et al. 2001). No specific data exist on longevity for this species, but other

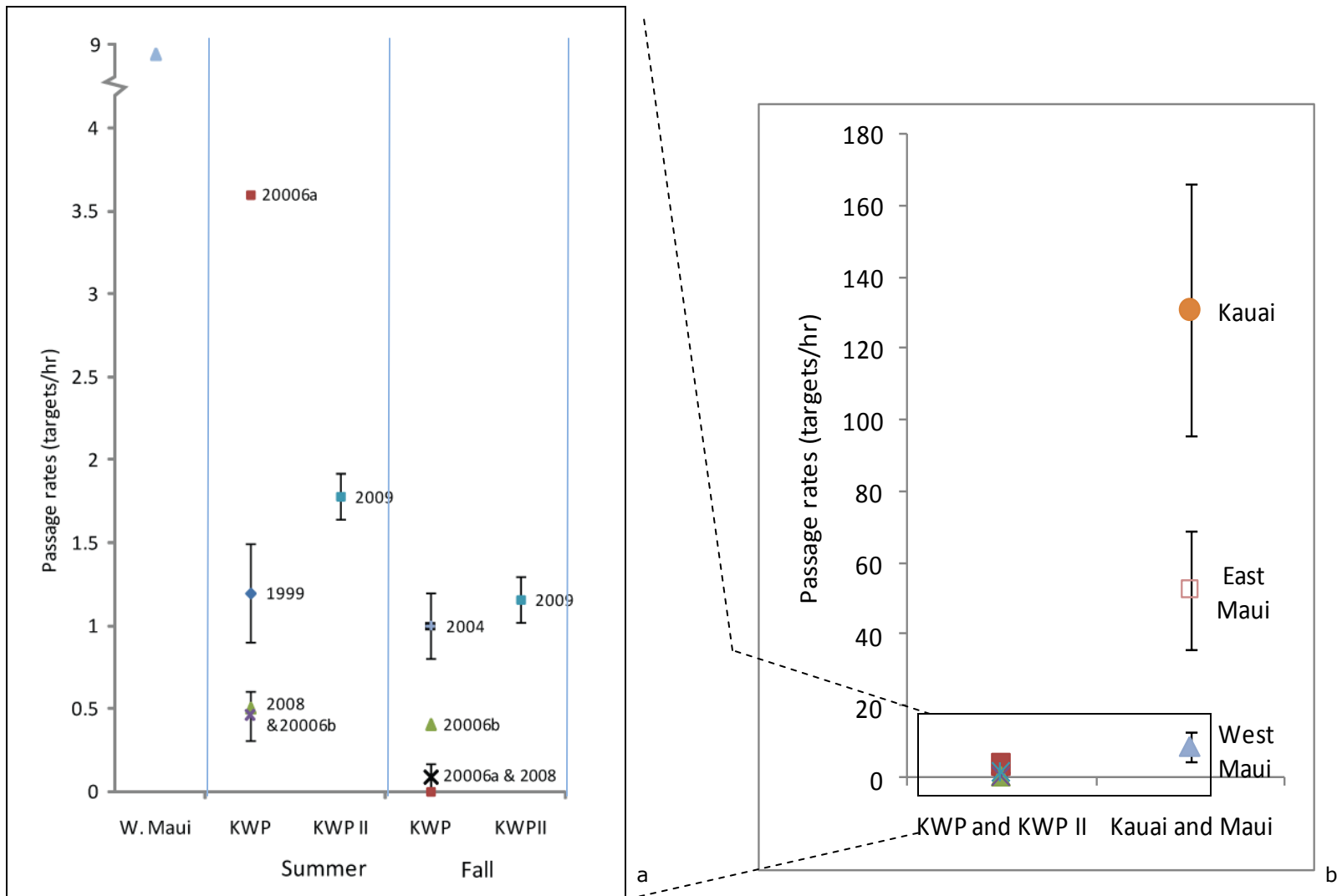


Figure 3.2. Comparison of passage rates of seabirds over KWP and KWP II with (a) West Maui and (b) East Maui and Kauai. Error bars are SE. Data points are labeled with the year the surveys were conducted. 2006 had two survey locations at KWP.

shearwaters may reach 30 years of age or more (see for example Bradley et al., 1989, del Hoyo et al. 1992).

The Newell's shearwater breeding season begins in April, when birds return to prospect for nest sites. A pre-laying exodus follows in late April and possibly May; egg-laying begins in the first two weeks of June and likely continues through the early part of July. Pairs produce one egg, and the average incubation period is thought to be approximately 51 days (Telfer 1986). The fledging period is approximately 90 days, and most fledging takes place in October and November, with a few birds still fledging into December (SOS Data).

3.8.2.2 Current Threats to the Newell's Shearwater

As stated above, radar studies on Kaua'i showed a 63% decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003a). It was presumed that the decrease in detections corresponded to an actual decrease in population, rather than simply a shift in areas used for breeding.

Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997, Mitchell et al. 2005, Hays and Conant 2007).

No Newell's shearwater fatalities have been recorded at KWP in the time since the ITP and ITL were issued in January 2006 (Kaheawa Wind Power LLC 2008b, 2008c).

3.8.2.3 Occurrence of Newell's Shearwater on Maui

Radar and night-visual observations by Day and Cooper (1999) and Cooper and Day (2004) indicate that Newell's shearwater nests somewhere in the West Maui Mountains, and that low numbers of these birds regularly fly over or near the proposed KWP II project area at night, to and from nesting colonies either in the West Maui Mountains or (occasionally) on Haleakalā. The size of the West Maui nesting population is unknown at this time.

3.8.2.4 Occurrence of Newell's Shearwater in the Project Area

As stated in Section 3.8.1.4., ABR Inc. conducted radar and night-visual observations over the KWP II project area in July and October 2009 (Cooper and Day 2009). The estimated number of Newell's shearwaters passing through the airspace of KWP II is 4.2 birds/night for the spring/summer season and 2.75 birds/night for the Fall. Visitation rates by adults to feed their chicks decline in the last quarter of the nestling period much like Hawaiian petrels.

Passage rates of seabirds (Hawaiian petrels and Newell's shearwaters combined) at KWP II are within the range of variability of passage rates observed upslope at KWP over the last ten years (Figure 3.2a). However, when comparing passage rates over other areas and islands of Hawaii, passage rates over the KWP and KWP II project area are lower than the mean rate measured for West Maui (8.7 ± 3.9 targets/hr, Figure 3.2a), East Maui (52.8 ± 16.6 targets/hr, Cooper and Day 2003, Figure 3.2b) and are less than 2.5 % of the mean passage rates measured on Kauai (131 ± 35 targets/hr, Day and Cooper 2001).

3.8.3 Nēnē

3.8.3.1 Population, Biology, and Distribution of the Nēnē

The nēnē is adapted to a terrestrial and largely non-migratory lifestyle in the Hawaiian Islands with negligible dependence on freshwater habitat. Compared to the related Canada goose (*Branta canadensis*), nēnē wings are reduced by about 16% in size and their flight capability is comparatively weak. Nonetheless, nēnē are capable of both inter-island and high altitude flight (Miller 1937; Banko et al. 1999).

After nearly becoming extinct in the 1940s and 1950s, the nēnē population slowly has been rebuilt through captive-breeding programs. Wild populations of nēnē occur on Hawai'i, Maui, and Kaua'i. The USFWS (2004) estimated that in the early part of this decade, the nēnē population numbered 1,300 individuals (USFWS 2004). The primary release site on Maui is located at Haleakalā National Park on East Maui where 511 nēnē were released between 1962 and 2003.

Since 1995, the majority of Maui releases have been from a release pen in the Hana'ula region of West Maui in an effort to establish a second population on Maui on this part of the island (F. Duvall, Maui DOFAW, pers. comm.). This pen is located near the upper end of the Kaheawa Pastures project area. Since 1994, 104 nēnē have been released at Hana'ula, compared with 18 at Haleakalā (USFWS 2004).

KWP is currently working with Maui DOFAW and USFWS to establish a new nēnē release pen on land owned by Haleakalā Ranch in East Maui. Nēnē will be released at this pen (total release numbers to be determined) for a period of 10 to 20 years in fulfillment of the KWP HCP mitigation program for nēnē.

The nēnē has an extended breeding season with eggs reported from all months except May, June, and July, although the majority of birds in the wild nest during the rainy (winter) season between October and March (Banko et al. 1999, Kear and Berger 1980). Nēnē nest on the ground in a shallow scrape in the dense shade of a shrub or other vegetation. A clutch typically contains three to five eggs and incubation lasts for 29 to 31 days. The female incubates the eggs, with the male standing guard nearby, often from an elevated location. Once hatched, the young remain in the nest for one to two days (Banko et al. 1999). Fledging of captive birds occurs at 10 to 12 weeks, but may occur later in the wild. During molt, adults are flightless for a period of 4 to 6 weeks. Molt occurs after hatching of eggs, such that the adults generally attain their flight feathers at about the same time as their offspring. When flightless, goslings and adults are extremely vulnerable to predators such as dogs, cats, and mongoose. From June to September, family groups join others in post-breeding aggregations (flocks), often far from nesting areas.

Nēnē occupy various habitat types ranging from beach strand, shrubland, and grassland to lava rock, at elevations ranging from coastal lowlands to alpine areas (Banko 1988; Banko et al. 1999). The geese eat plant material, and the composition of their diet depends largely on the vegetative composition of their surrounding habitats. They appear to be opportunistic in their choice of food plants as long as the plants meet their nutritional demands (Banko et al. 1999; Woog and Black 2001).

3.8.3.2 Current Threats to Nēnē

Current threats to nēnē include predation by non-native mammals, exposure in high-elevation habitats, insufficient nutritional resources for both breeding females and goslings, a lack of lowland habitat, human-caused disturbance and mortality (e.g., road mortality, disturbance by hikers), behavioral problems related to captive propagation, and inbreeding depression (USFWS, unpubl., USFWS 2004). Predators of nēnē eggs and goslings include dogs, cats, rats and mongoose. Dogs and mongoose are also responsible for most of the known cases of adult predation (USFWS 2004). Nēnē have also been negatively impacted by human recreational activities (e.g., hikers and hunters). In recent years, nēnē have been struck and killed by golf balls and vehicles (USFWS 2004).

Starvation and dehydration can be major factors in gosling mortality. Approximately 81.5% of gosling mortality in Haleakalā National Park during the 1994 to 1995 breeding season was due to starvation and dehydration (USFWS 2004). From 2005 to 2007, between 30 to 50% of the goslings at the Hakalau Forest Unit died due to drought and/or exposure (USFWS, unpubl. report). A lack of adequate food and water supplies also seems to be a limiting factor in Hawai'i Volcanoes National Park (USFWS 2004).

In order for nēnē populations to survive, they must be provided with generally predator-free breeding areas and sufficient food resources, human-caused disturbance and mortality must be

minimized, and genetic and behavioral diversity maximized. At the same time, it is recognized that nēnē are highly adaptable, successfully utilizing a gradient of habitats ranging from highly altered to completely natural, which bodes well for recovery of the species.

Three nēnē fatalities have been observed since the beginning of operations at KWP in 2006 (Kaheawa Wind Power LLC 2008b, 2009). Section 5.2.4.1 provides additional information concerning these fatalities.

3.8.3.3 Occurrence of Nēnē in West Maui and the Project Area

The Hana'ula release pen is located near the upper end of the existing KWP project area, approximately 1,800 feet (550 m) from the nearest KWP wind turbine. A number of nēnē from the Hana'ula release site have remained as residents within or near the KWP project area. Little is known about the exact distribution and movements of the birds released at the Hana'ula release pen, although they have been recorded as far west as Lahaina (approximately 7.7 miles or 12.3 km from the project area) and as far east as Haleakalā National Park, indicating that at least some birds from this release site move extensively around the island (J. Medeiros, Maui DOFAW, pers. comm.). The nēnē population in this region is monitored under the KWP HCP and survey effort is now well coordinated between DOFAW and KWP biologists.

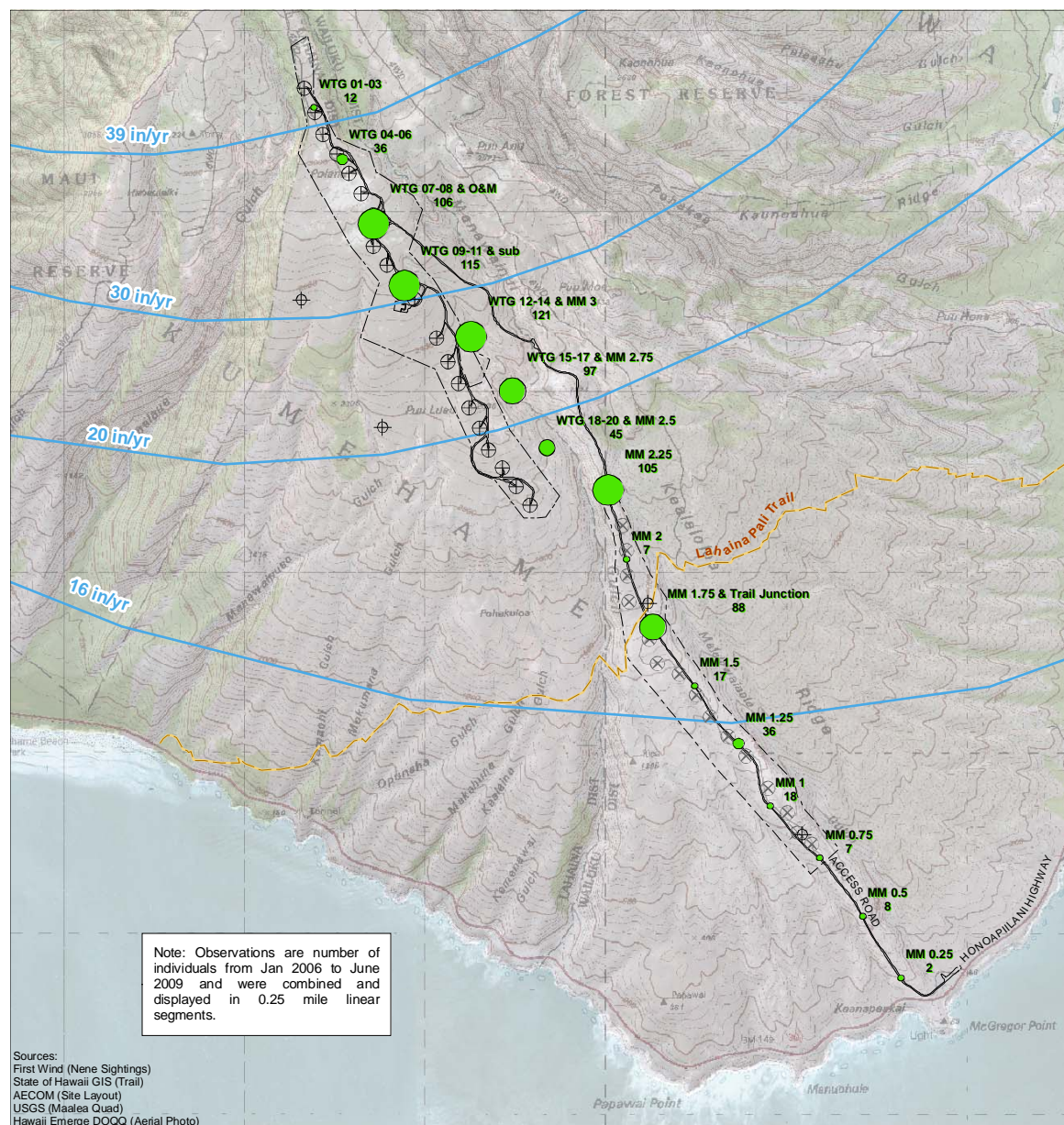
In 1998, four goslings were successfully fledged from the first nest reported in the area since reintroduction began (DOFAW 2000). As of the date of this report, monitoring studies at KWP have resulted in discovery of a few nēnē nests in the vicinity. One successful nest was discovered in 2007 about 330 feet (100 m) to the west of turbine WTG-15. Spencer (pers. comm.) reported that most nesting activity is observed well to the west and southwest of the KWP area but seldom, if ever, within the KWP II area.

Nēnē presence and nesting behavior has been regularly monitored in the KWP project area prior to and after commencing operation of KWP. Data collected from incidental surveys and the WEOP program (December 2006 – June 2009), have provided information about nēnē distribution and behavior at KWP and KWP II. Monitoring of nēnē during the construction period at KWP (January to June 2006) also documented nēnē use of the KWP area and downroad KWP II area. Both these data sets combined provide over 800 observations ($n = 820$ individuals) on nēnē distribution and span over three and a half years³. Results show that nēnē are seen almost twice as frequently ($n = 532$ individuals) at the KWP area than at the KWP II downroad area ($n = 288$, Figure 3.3). Most of the downroad observations are in the upper elevations of the KWP II area, near the Pali Trail Junction (Mile Marker 1.75) and in the vicinity of MECO's 64kV overhead transmission route crossing (Mile Marker 2.25). The birds periodically use the area for browsing and socializing (Spencer pers. comm.). No nesting is expected to occur within the KWP II project area (see above).

In addition to the WEOP observations, systematic surveys were also conducted at KWP and consisted of 116.8 hours of observation time from June 2006 to June 2007. The primary purpose of the systematic surveys was to record nēnē flight behavior around the existing KWP wind facility. Surveys were conducted in the mornings (6 - 10 am), afternoons (10 am - 2pm) and evenings (2 pm - 6 pm). Systematic surveys show that flight activity did not vary with time of day (range = 0.29 – 0.38 flocks in flight/hr; $X^2 = 0.464$, $df = 2$, $p = 0.79$).

Data from the WEOP surveys and systematic surveys combined document that nēnē frequently fly within the rotor-swept zone (RSZ) of the turbines at KWP (66.1% of all flights observed, $n=97$) with 16.9% occurring below the RSZ and also 16.9% above. The low mortality of nēnē mortality observed at KWP is likely attributable to their diurnal flight behavior, detection capacity, and maneuverability which, under most conditions enable them to successfully avoid the turbines and

³ In order to standardize effort spent surveying both KWP and KWP II areas, data were chosen only from time periods when the entire stretch of road leading from the base of KWP II to KWP was surveyed. For WEOP observations, the two time periods that fit this criterium were 6:30 – 9:00 am and 3:30 to 7:00 PM. As the entire roadway was surveyed during the construction period, all nēnē observations were used from that dataset.



Legend

--- KWP & KWP II
 Project Area
 — Lahaina Pali Trail
 — Rainfall Contour Lines
 MM - Mile Marker
 O&M - Operations & Maintenance
 Sub - Substation
 WTG - Wind Turbine Generator

Existing KWP Structures

⊕ Turbines
 ⊕ Met Towers

Proposed KWPII Structures

⊗ Turbines
 ⊗ Met Towers

Nēnē Sightings

● 2 - 20
 ● 21 - 40
 ● 41 - 60
 ● 61 - 80
 ● 81 - 100
 ● 101 - 121

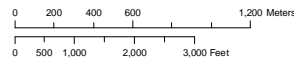


Figure 3.3. Distribution of nēnē at KWP and KWP II areas

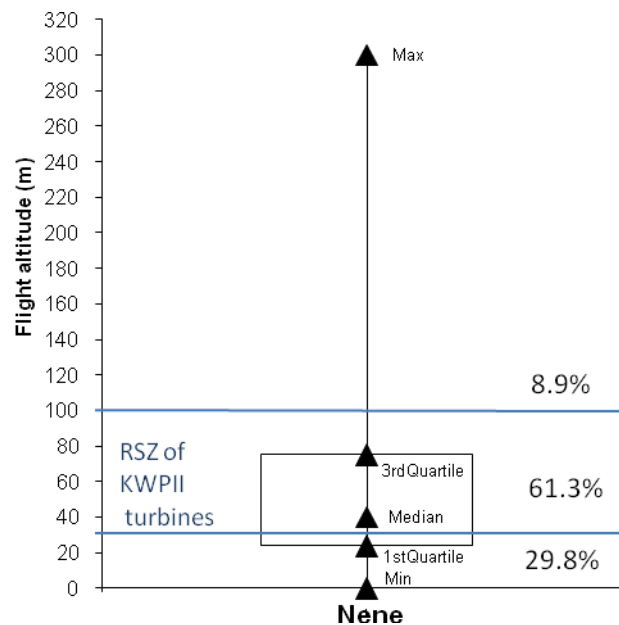


Figure 3.4 Flight altitudes of nēnē from WEOP and systematic observations (n=97), imposed on the RSZ of turbines at KWP II. Percentages on the right are the percentages of nēnē flights expected to occur at, below and above the RSZ.

met towers (Spencer pers comm.). Two of the three documented nēnē fatalities at KWP were closely correlated with abrupt and severe shifts in weather that may have reduced their visual acuity and compromised their maneuvering abilities. As turbine towers at KWP II will be 10 m taller, the RSZ height is also raised by 10 m (the area remains the same). Assuming that flight characteristics of nēnē at KWP II are similar to those observed at KWP, slightly fewer nēnē (61.3%) are expected to be flying at RSZ height at KWP II, further reducing collision risk (Figure 3.4). In addition, the KWP II site is situated at an elevation that reduces its propensity for dense cloud cover that may improve the visual response of nēnē encountering turbines in their airspace. Flock sizes in flight averaged 2.7 birds.

In summary, fewer nēnē are seen in the KWP II downroad area compared to KWP. Applying nēnē behavioral observation at KWP to KWP II, nēnē may transit through the KWP II area at any time during daylight hours. As KWP II turbine towers are 10 m taller than the KWP turbines, fewer nēnē flocks will fly within the RSZ of the KWP II turbines (61% vs. 66%) and the flight avoidance behavior observed at KWP is expected to further lower the risk of take at KWP II. The greater visibility on site due to the lower elevation, and resulting decrease in the frequency and extent of cloud cover, of KWP II, could also potentially decrease the risk of turbine collision for nēnē.

3.8.4 Hawaiian Hoary Bat

3.8.4.1 *Population, Biology, and Distribution of the Hawaiian Hoary Bat*

The Hawaiian hoary bat is the only existing native terrestrial mammal from the Hawaiian archipelago (USFWS 1998). The species has been recorded on Kaua'i, O'ahu, Moloka'i, Maui, and

Hawai'i, but no historical population estimates or information exist for this subspecies. Population estimates for all islands in the state in the recent past have ranged from hundreds to a few thousand bats (Menard 2001). The Hawaiian hoary bat is believed to occur primarily below an elevation of 4,000 feet (1,220 m). This subspecies has been recorded between sea level and approximately 9,050 feet (2,760 m) in elevation on Maui, with most records occurring at or below approximately 2,060 feet (628 m) (USFWS 1998).

Hawaiian hoary bats roost in native and non-native vegetation from 3 to 29 feet (1 to 9 m) above ground level. They have been observed roosting in 'ōhi'a, hala (*Pandanus tectorius*), coconut palms (*Cocos nucifera*), kukui (*Aleurites moluccana*), kiawe (*Proscopis pallida*), avocado (*Persea americana*), mango (*Mangifera indica*), shower trees (*Cassia javanica*), pūkiawe (*Styphelia tameiameia*), and fern clumps; they are also suspected to roost in eucalyptus (*Eucalyptus* spp.) and Sugi pine (*Cryptomeria japonica*) stands. The species is rarely observed using lava tubes, cracks in rocks, or man-made structures for roosting. While roosting during the day, Hawaiian hoary bat are solitary, although mothers and pups roost together (USFWS 1998).

Preliminary study of a small sample of Hawaiian hoary bats (n=18) on the Island of Hawai'i have estimated short-term (1-2 weeks) home range sizes of 104.8 ± 94.9 (SD) ac (42.4 ± 38.4 ha) with core areas of approximately 13.3 ± 13.6 (SD) ac (5.4 ± 5.5 ha, USGS, unpublished data). The size of home ranges and core areas varied widely among individuals. Core areas included feeding ranges that were actively defended, especially by males, against conspecifics. For some individuals, core areas included night roosts, but typically did not include day roosts. Roosting and feeding areas may be disjunct as the average long-axis (maximum length of home range) was 2.7 ± 2.9 (SD) mi (4.4 ± 4.6 km), with a maximum length of 11.1 mi (17.8 km), indicating that some individuals travelled long distances between roosting and feeding areas.

It is thought that breeding occurs primarily between April and August. Breeding has only been documented on the islands of Hawai'i and Kaua'i (Baldwin 1950, Kepler and Scott 1990, Menard 2001). It is not known whether bats observed on other islands breed locally or only visit these islands during non-breeding periods. Seasonal changes in the abundance of Hawaiian hoary bat at different elevations indicate that altitudinal migrations occur on the island of Hawai'i. During the breeding period, Hawaiian hoary bat occurrences increase in the lowlands and decrease at high elevation habitats. Hawaiian hoary bat occurrences are especially low from June until August in high elevation areas. In the winter, especially during the post-lactation period in October, bat occurrences increase in high elevation areas and in the central highlands, possibly receiving bats from the lowlands (Menard 2001).

Hawaiian hoary bats feed on a variety of native and non-native night-flying insects, including moths, beetles, crickets, mosquitoes, and termites (Whitaker and Tomich 1983). They appear to prefer moths ranging between 0.60 and 0.89 inches (16 to 20 mm) in size (Bellwood and Fullard 1984, Fullard 2001). Prey is located using echolocation. Water courses and edges (e.g., coastlines and forest/pasture boundaries) appear to be important foraging areas. In addition, the species is attracted to insects that congregate near lights (USFWS 1998, Mitchell et al. 2005). They begin foraging either just before or after sunset depending on the time of year (USFWS 1998, Mitchell et al. 2005).

3.8.4.2 Current Threats to the Hawaiian Hoary Bat

The availability of roosting sites is believed to be a major limitation in many bat species. Possible threats to the Hawaiian hoary bat include pesticides (either directly or by impacting prey species), predation, alteration of prey availability due to the introduction of non-native insects, and roost disturbance (USFWS 1998). Management of the Hawaiian hoary bat is also limited by a lack of information on key roosting and foraging areas, food habits, seasonal movements and reliable population estimates (USFWS 1998).

In their North American range, hoary bats are known to be more susceptible to collision with wind turbines than most other bat species (Johnson et al. 2000, Erickson 2003, Johnson 2005). Most mortality has been detected during the fall migration period. Hoary bats in Hawai'i do not migrate in the traditional sense, although as indicated some seasonal altitudinal movements occur.

Currently, it is not known if Hawaiian hoary bats are equally susceptible to turbine collisions during their altitudinal migrations as hoary bats are during their migrations in the continental U.S.

3.8.4.3 Occurrence of the Hawaiian Hoary Bat in West Maui and the Project Area

On Maui, this bat is believed to occur primarily in moist, forested areas, although little is known about its exact distribution and habitat use on the island, especially in the West Maui Mountains. No Hawaiian hoary bats were recorded in the area of the proposed wind turbines during nighttime visual studies using night vision equipment conducted in summer 1999 (Day and Cooper 1999) or fall 2004 (Cooper and Day 2004a).

Hawaiian hoary bats are not expected to breed or roost in the project area due to the lack of trees in the grassland dominated landscape. Bats are likely to be using the KWP II area for foraging only.

Since the HCP for KWP was approved and the existing facilities began operation in the summer of 2006, KWP has carried out regular bat monitoring in accordance with the provisions of its HCP. The results of these observations as summarized below have greatly increased the information that is available on the presence of the Hawaiian hoary bat at Kaheawa Pastures and confirm that the species is present in low numbers in the KWP project area. Due to their proximity to each other and some similarities in habitat structure at KWP and KWP II, it is expected that bat activity at KWP II will likely be comparable.

Visual Surveys for Flying Bats at KWP. In accordance with the provisions of the KWP HCP, KWP biologists carried out regular crepuscular and nocturnal surveys aimed at recording bat activity at Kaheawa Pastures from June 2006 through June 2007. During this period, KWP biologists performed 32 surveys totaling nearly 116 hours of observation effort in and around the KWP site and adjacent countryside. Initially, surveys were conducted in the vicinity of each of the wind turbines on the site; however, the survey area was extended to include some of the adjacent gulches (KWP, LLC. 2007). The sites were surveyed during winter and spring seasons and under a range of weather and survey conditions. Though there often appeared to be abundant aerial insect prey and favorable wind conditions for minimally encumbered flight, no positive observations of Hawaiian hoary bats were made during either survey period (KWP, LLC. 2007, 2008a). Two separate bat sightings were reported by contractors between July 2007 and June 2008. One observation occurred on the access road below the Pali trail on February 20, 2008 and the other at the Operations and Maintenance building on April 5, 2008 (KWP, LLC. 2008b, Appendix 4). KWP biologists conducted interviews and in both cases the reports remained inconclusive.

Visual Surveys for Downed Bats. KWP biologists also looked for bats as part of their year-round monitoring aimed at documenting all downed (i.e., injured or dead) Covered Species in the project area. On October 3, 2008, a single dead bat was found near WTG 8. Injuries to the bat suggested it had died of physical trauma, presumably having collided with a turbine rotor or the tower. This was the first and to date only observed bat fatality associated with the KWP project since issuance of the ITP and ITL (January 2006).

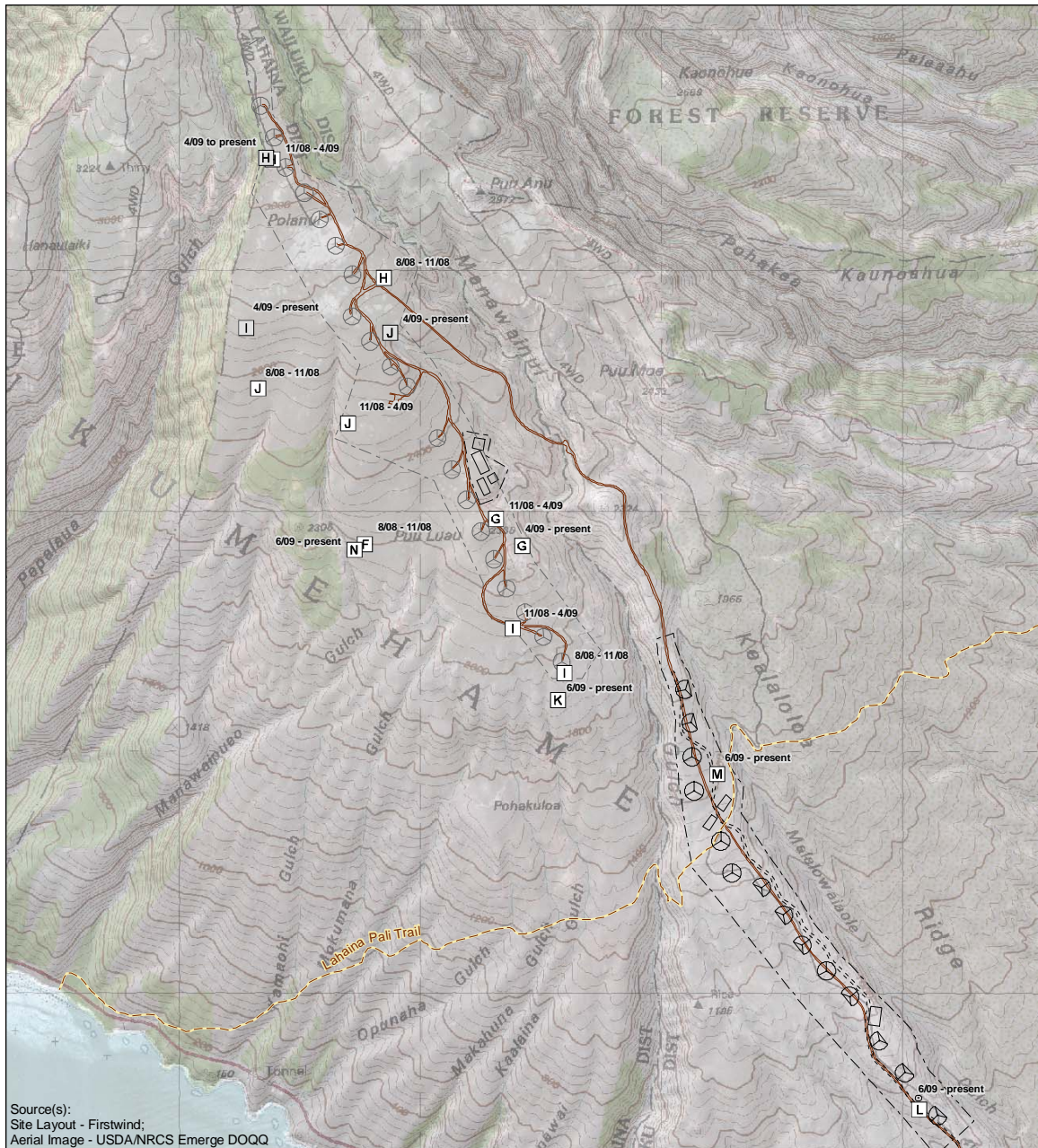
Acoustic Monitoring of Bat Activity at KWP Since August 2008, four to eight Anabat detectors (Titley Electronics, NSW, Australia) have been deployed at various locations in Kaheawa Pastures (Figure 3.5, Kaheawa Wind Power LLC 2008). Bat detectors were placed from ground level to 15 ft (4.6 m) and have a detection radius of approximately 98 ft (30 m). Given the paucity of data on bat distribution in Hawai'i, the primary goal of these detectors was to determine bat absence/presence in the area and subsequently quantify bat activity if detected. These detectors do not document bat activity in the rotor swept zone which typically begins at heights above 98 ft (30 m).. Surveys conducted at wind farms in the continental US typically exhibit notably higher frequencies of detection at detectors placed near the ground versus those placed within the RSZ (Robert Roy, pers. comm.). These detectors record ultrasonic sounds, which are then analyzed using Analook® computer software to determine if bat calls were recorded. Bat call sequences

were all detected between the months of April through November and no calls were recorded between December and March (Table 3.5).

Twenty six bat call sequences, of which nineteen qualified as bat passes, were recorded by the four detectors over the sampling period (see Table 3.5 for data and definitions). This equates to a detection rate of 0.010 passes/detector/night (19 bat passes/1997 detector-nights). This is less than 2% of the detection rates measured during a study being conducted by U.S. Geological Survey (USGS) at Hakalau National Wildlife Refuge on the Island of Hawai'i (0.66 bat passes/detector/night) (Bonaccorso, unpub. 2008).

Table 3.5 Results of Acoustical Bat Monitoring at KWP

			Number of Operating Nights	Number of Call Sequence Files	Qualifying Bat Passes**	Detection Rate (passes/detector- night)
Detector	Survey Periods	Survey Dates*				
Unit F	August to November	Aug 8 - Nov 14	81	3	2	0.02
Unit H		Aug 8 - Nov 14	99	7	3	0.03
Unit I		Aug 8 - Nov 14	99	4	2	0.02
Unit J		Aug 8 - Nov 14	99	1	0	0
Unit G	November to April	Nov 12 - Apr 8	147	0	0	0
Unit H		Nov 12 - Apr 15	154	0	0	0
Unit I		Nov 12 - Apr 15	154	0	0	0
Unit J		Nov 12 - Jan 1 Mar 4 - Apr 5	88	0	0	0
Unit G	April to June	Apr 28 - Jun 30	75	0	0	0
Unit H		Apr 17 - Jun 30	86	1	1	0.012
Unit I		Apr 17 - Jun 30	86	0	0	0
Unit J		Apr 28 - Jun 30	75	0	0	0
Unit K	June to September	Jun 2 - Jun 30	28	0	0	0
Unit L		Jun 2 - Jun 30	28	0	0	0
Unit M		Jun 2 - Jun 30	28	0	0	0
Unit N		Jun 2 - Jun 30	28	0	0	0
Unit G		Jun 30 - Sept 23	85	0	0	0
Unit H		Jun 30 - Sept 23	85	7	7	0.082
Unit I		Jun 30 - Sept 4	66	0	0	0
Unit J		Jun 30 - Sept 23	85	1	1	0.012
Unit K		Jun 30 - Sept 23	85	0	0	0
Unit L		Jun 30 - Sept 23	85	3	3	0.035
Unit M		Jun 30 - Sept 23	85	0	0	0
Unit N		Jun 30 - Sept 23	66	0	0	0
Totals			1997	27	19	0.010



Legend

- | | |
|-----------------------------------|---------------------|
| Anabat Sensors (Dates in Service) | KWP Project Area |
| Proposed KWP II Turbines | KWP II Project Area |
| Existing KWP I Turbines | Proposed Buildings |
| | Lahaina Pali Trail |
| | Proposed Road |
| | Existing Road |

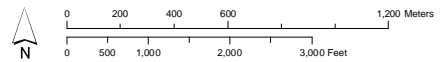


Figure 3.5. Locations of Anabat detectors at Kaheawa Pastures

4.0 BIOLOGICAL GOALS & OBJECTIVES

4.1 GENERAL

KWP II LLC has worked cooperatively with USFWS and DLNR to assess the potential for the proposed project to cause adverse impacts to the four Covered Species through site-specific studies, and has taken all appropriate and practicable steps to avoid and minimize the potential for adverse impacts. Where the potential for impacts is unavoidable, this HCP provides means to minimize and mitigate any adverse impacts to Covered Species that may occur, and to provide a net conservation benefit.

This HCP has goals and objectives based on the species populations rather than their habitats. The proposed wind energy generation facility is anticipated to directly or indirectly impact individuals of the four Covered Species, but will have only minor, negligible impacts on the amount or quality of habitats for these species.

Specific biological goals of this HCP are to:

- Minimize and mitigate, to the maximum extent practicable, the effects of take caused by the wind energy generation facility;
- Increase the knowledge and understanding of the four Covered Species' occurrence and behavior in the project vicinity;
- **Contribute** to the goals of USFWS nēnē draft revised recovery plan and DOFAW's Nēnē Restoration Project;
- **Contribute** to goals of the recovery plans for the other three species, considering the most recent updated information and goals; and
- Provide a net conservation benefit to each of the four Covered Species.

4.2 PROJECT ALTERNATIVES

The proposed project design was described in Section 1.4. Before evaluating the potential impacts of the proposed project, and before discussing measures to avoid and minimize potential impacts, it is helpful to understand how the project area and design were ultimately chosen over other possible alternatives.

4.2.1 No-Action Alternative: "No Build"

The "no-action" alternative is a "no build" alternative that would mean a commercial wind energy generation facility would not be constructed and operated by KWP II LLC at this location on Maui. KWP II LLC is a business entity created for this sole purpose, with a majority partner that is a leader in the wind power industry – so a "no build" alternative is contrary to the Applicant's fundamental purpose and objective. The "no build" scenario also fails to serve the purpose, intent, and requirements of Act 95 (S.B. 2474, S.D. 3, H.D. 2, signed by Governor Linda Lingle on June 2, 2004), which establishes renewable energy portfolio standards for Hawai'i's electric utilities. Act 95 requires each electric utility to establish a renewable portfolio standard of 8% by the end of 2005, 10% by the end of 2010, 15% by the end of 2015, and 20% by the end of 2020. The "no build" alternative, then, does not support the State's desire to develop viable renewable energy sources, as well as MECO's obligation to meet these milestones, and KWP II LLC's business plan to contribute to these goals.

The no-build scenario would result in no take of the Covered Species and no implementation of any mitigation measures. There would be no changes to the site or to existing habitats, nor any potential for collision with wind turbines or project infrastructure. However, without the proposed mitigation measures, there would be no contributions to recovery efforts, and no further study or habitat protection funded by the project. In view of the fact that these are expected to provide a net benefit to the species, the "no-build" scenario does not have any positive effect on the species.

Lastly, the “no build” scenario would maintain the status quo of Maui’s electric energy production, its dependence on imported oil and the emissions thereof. The broad economic and environmental benefits of a commercial wind energy generation facility would be foregone.

4.2.2 Alternate Project Location

Few other sites on Maui have as robust and reliable a wind regime as Kaheawa Pastures. In addition, the site’s proximity to KWP allows the proposed new facilities to share infrastructure such as the main access road, some equipment storage and parts, and to a smaller extent, personnel, with the KWP project. KWP II LLC and KWP would enter into a formal agreement to allow the sharing of these resources. Other wind-rich sites on Maui are located in areas that lack adequate transmission capability, are closer to/more visible from populated areas, or have other constraints. Because of the ability to share resources with KWP, other things being equal, the Applicant believes that building a facility with similar production capability at another site would result in greater costs and environmental impacts than building in the proposed location.

Moreover, other sites suitable for wind development on Maui present comparable challenges in terms of topography, visibility, natural resources, and sensitive flora and fauna without having comparable benefits. Operation of the existing KWP has produced data pertaining to the Covered Species at the proposed location which has been used to more accurately estimate levels of take for each Covered Species at the proposed KWP II site. At an alternate location, the species vulnerable to take by a proposed wind facility may be different from the Covered Species in this HCP. The levels of take for those species also may change at an alternate project location, depending on movement rates and the potential level of interaction of each species with the wind facility. These take levels would have to be determined from wildlife surveys and other existing information, but would not have the benefit of long-term data that is available for the proposed location.

Therefore, the Applicant has concluded that the proposed project location is superior to the alternatives that are available for its project.

4.2.3 Alternate WTG Locations at Kaheawa Pastures

KWP II LLC initially considered three potential WTG siting areas (Upwind, Downwind/Downstring, and Downroad) at Kaheawa Pastures. The Upwind and Downwind/Downstring siting areas are at similar elevation to KWP but the Downroad area (proposed site) is at a lower elevation. KWP II LLC used ground-truthing and meteorological data to identify individual WTG locations. The siting areas are shown on Figure 4.1 along with the existing KWP and proposed KWP II WTG layouts. All three potential WTG siting areas are within the same general area, and the same Covered species would have potential to be impacted regardless of the site chosen. The greater visual impacts and logistical challenges of developing on new ridgeline led KWP II LLC to eliminate the Upwind site from further consideration. Initial impact analyses led KWP II LLC to conclude that use of the Downwind/Downstring site was likely to cause greater impacts to Covered Species or their habitats than was use of the Downroad site (proposed site). Measurements of passage rates of seabirds at lower elevations have shown that passage rates are generally similar to those previously recorded at higher elevations at KWP (see Figure 3.2a). Due to the similarity of habitat, bats are also expected to be infrequently present Downroad as they are at KWP. Nēnē are less frequently seen at lower elevations, thus use of the lower elevation Downroad site is likely to have a smaller impact on the resident nēnē population than higher elevation sites (Upwind and Downwind/Downstring). The following sub-sections outline the reasons the Upwind and Downwind/Downstring siting areas were eliminated and explain the criteria the Applicant used for micro-siting individual WTGs within the Downroad site.

4.2.3.1 Upwind Siting Area

The Upwind siting area that was considered is located on the east side of the existing main access road approximately 2,000 feet (610 m) to the east (i.e., on the Central Valley side) of the KWP turbines. Preliminary analyses indicated this area could accommodate up to 15 WTGs. However, the Upwind area possesses several drawbacks. Constructing turbines in this area would require the Applicant to lease additional land (up to an additional 250 acres) and to construct an access road across the intervening gulch and onto a second, presently undeveloped ridgeline. A new overhead collection line would be required to connect the turbines with the electrical substation and existing MECO power transmission system. Visual simulations also indicated that turbines placed in this area would be much more visible to surrounding communities than the other locations considered. Finally, existing information and reconnaissance of the area suggested that the distribution of Covered Species was not likely to be significantly different at the Upwind site.

4.2.3.2 Downwind/Downstring Siting Area

The Downwind/Downstring siting area is located approximately south-west of the existing KWP facility, along the same ridgeline. Preliminary analyses indicated that the Downwind/Downstring area could accommodate up to 14 WTGs. Though feasible, construction of the facility would have required almost one and a half times the earthwork to put in the required road network for access to project components than at the proposed site (Downroad). This would have resulted in greater ground disturbance, potential for erosion, and the need for revegetation. Nēnē are twice as likely to be found at higher elevations consistent with existing KWP and Downwind/Downstring areas (see section 3.8.3.3, Figure 3.3) than at the proposed lower elevation Downroad site, likely due to the proximity of better nesting and foraging habitat in the Downwind/Downstring areas. Consequently, risk of nēnē collision with turbines is probably also greater at the Downwind/Downstring area than at the proposed site.

Impacts to seabirds at the Downroad site are anticipated to be generally similar to those modeled Downwind/Downstring, as Summer passage rates at these two elevations are similar (Section 3.3.8.1.4, Fall surveys at KWP II are still pending). However, the Downwind/Downroad alternative would require up to three permanent met towers, as opposed to one at the proposed site, which would create additional collision hazards for seabirds and nēnē. Bats were expected to be impacted to the same degree at both sites due to similarities in terrain and available habitat (Section 3.8.4.3). One positive feature of the Downwind/Downstring alternative was the smaller visual impact it would present to the residents of Maui. However, when weighed against the greater impacts of this alternative to several Covered Species, particularly nēnē, the Downwind/Downstring alternative was less favored than the proposed alternative.

4.2.3.3 Individual WTG Locations at Kaheawa Pastures

The Applicant considered several factors in narrowing down suitable locations for individual WTG installation at the KWP II facility. These included the viability of the wind resource, proximity and orientation to the existing KWP turbines (which can affect the efficiency and output of the facility), visibility to the Maui community, presence of sensitive resources (e.g., native flora and fauna, cultural features, aesthetic, etc.), and constructability (i.e., site topography, geological features, and extent of road-building required).

Observed conditions at KWP, as well as meteorological data collection and ground surveys in the KWP II project area helped to support the micro-siting of WTGs within the preferred Downroad siting area. The Applicant also used these factors for early elimination of potential turbine siting areas. For example, the area north (mauka) of the KWP site was not seriously considered for placement of WTGs because it supports a greater representation of native biota and lacks the wind resource of the Downwind/Downstring and Downroad siting areas.

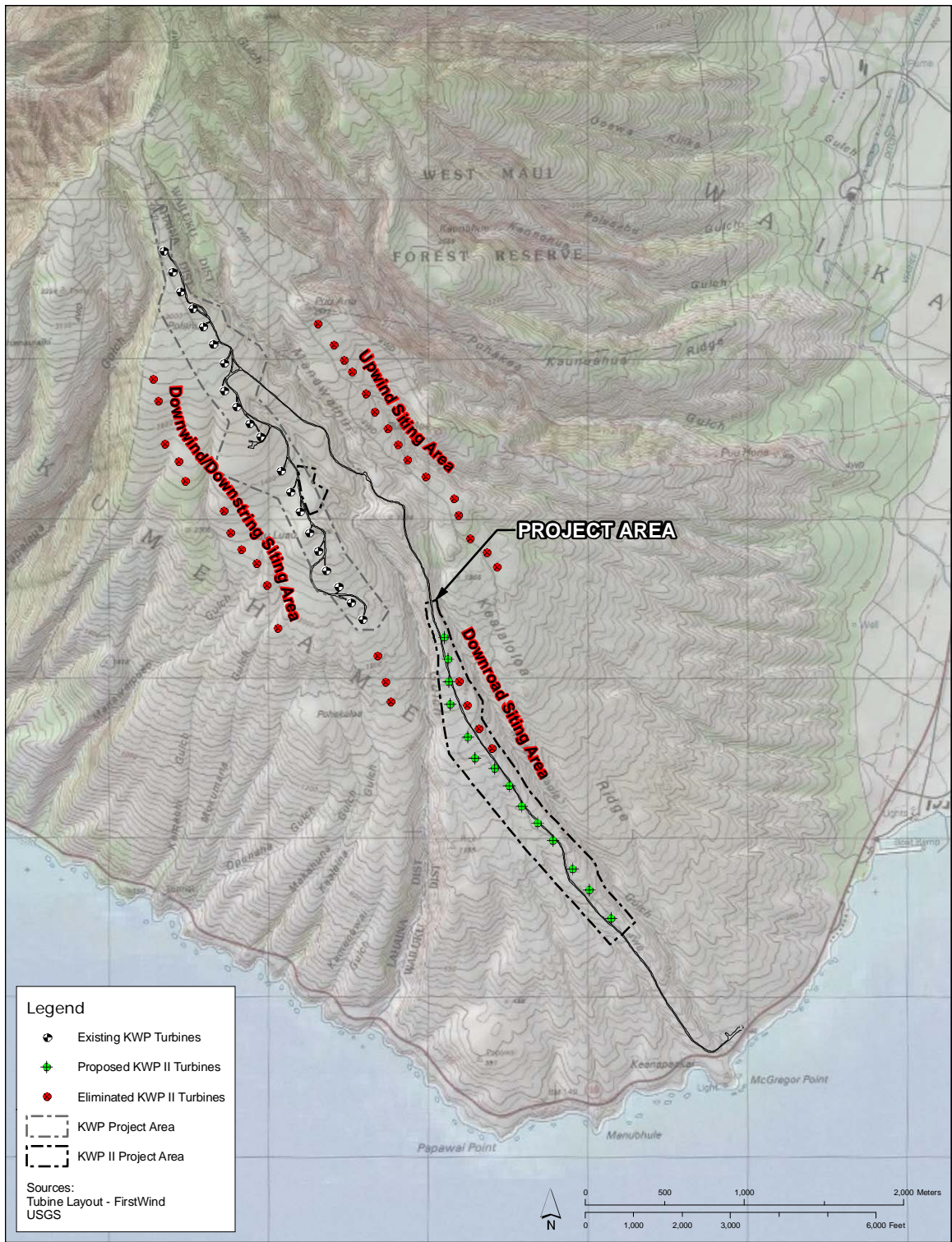


Figure 4.1. Siting Areas Eliminated from Further Consideration

4.2.4 Greater or Fewer Number of WTGs

The *EA/EISPN* for the project identified a range of possible generating capacities for KWP II, from 10.5 MW (in accordance with the capacity identified in the latest MECO Integrated Resource Management Plan (IRP-3) as being appropriate for development by 2011) to 30 MW. Feedback on the *EA/EISPN*, analyses of the wind and meteorological data that KWP II LLC has collected, and the fixed cost of the required battery storage facilities have led the Applicant to select 21 MW as the appropriate capacity for the facility. The following discussions describe the reasons why the Applicant has decided not to consider alternatives that involve a greater or lesser generating capacity than the proposed 21-MW facility.

4.2.4.1 Reduced Scale Project (<21 MW)

MECO submitted its IRP-3 to the State of Hawai'i Public Utilities Commission on April 30, 2007. This plan calls for the addition of another 10.5 MW of as-available wind generating capacity in 2011 (the output of seven 1.5-MW machines of the type that the Applicant is proposing to use). The limited amount of new wind generating capacity that is identified in the IRP-3 is largely a function of MECO's assessment of its ability to integrate electricity from a variable source such as wind into the island-wide system. The Applicant does not believe that the potential revenue from such a limited generating capacity justifies the cost of developing the needed support infrastructure.

Moreover, discussions that have occurred between MECO and potential wind energy developers since the IRP-3 was prepared indicate that MECO is now willing to attempt to integrate more than 10.5 MW of wind generating capacity into its system so long as it is accompanied by provisions which buffer MECO's system against short-term fluctuations.⁴

KWP II LLC believes that reducing the capacity of the facility below 21 MW would decrease the benefits of further wind power development without providing off-setting environmental benefits. Moreover, lowering the number of WTGs would not produce a proportional reduction in the cost of the support facilities and permitting. This, combined with the high fixed costs of transportation, logistics, mobilization, and other factors mean that the cost per MW of capacity increases as the number of turbines decreases. Although a reduced scale project from 14 to seven (7) turbines likely would reduce the risk of adverse impacts to the Covered Species, the reduction in biological impacts is not sufficient to overcome the economic and logistical considerations. For these reasons, the Applicant believes it is financially infeasible to consider constructing a facility with fewer than 14 1.5-MW WTGs.⁵

4.2.4.2 Increased Scale Project (>21 MW)

Sufficient space is available to construct at least 14 additional WTGs in the Kaheawa Pastures area. However, in order to engineer a successful utility integration design, KWP II LLC does not propose installing more than 14 1.5-MW WTGs in the project area at this time. Moreover, an increase in the number of turbines will proportionately increase impacts on the Covered Species.

4.2.5 Turbine Design and Size

The KWP facility installed GE 1.5-MW WTGs. These have proven to be a good match for the wind regime at Kaheawa Pastures. These WTGs are sufficiently large to take advantage of economies of scale and the higher wind speeds that are present at heights above those that can be reached

⁴ The exact magnitude and nature of the buffer that is needed to protect MECO's system is the subject of ongoing discussions between MECO and potential wind developers, including KWP II LLC.

⁵ The announced size (40 MW of installed capacity) of a proposed Shell Wind Energy project on Maui is almost twice that of KWP II, suggesting that these economic limitations are not unique to KWP II LLC.

by smaller/lower wind turbine generators, yet they are considerably shorter and less massive than the larger WTGs that are now being put into service in some areas.⁶

The Applicant is proposing to also use GE 1.5-MW turbines, which will be nearly identical in appearance to those present at KWP, though about 33 feet (10 m) taller in overall height due to manufacturer's design changes.⁷ Using the same type of WTGs for KWP II as have been used at KWP will help ensure visual and logistical continuity for the facilities at Kaheawa Pastures. This would decrease the overall visual impact of the facilities and streamline the delivery and exchange of parts between them.⁸

Economic analyses performed by the Applicant indicate that the 1.5-MW GE turbines are likely to be the most cost-effective choice for this location. Finally, it is believed the GE 1.5-MW turbines can meet the requirements that MECO is likely to set on the basis of the Interconnect Requirement Study that it will conduct as part of the Power Purchase Agreement negotiations.

4.3 AVOIDANCE AND MINIMIZATION OF IMPACTS

4.3.1 Site-Specific Project Design Considerations

The analysis of project design alternatives supports the conclusion that the Proposed Action is preferred when all impacts on the human and natural environment are considered. Because complete avoidance of risk to the four Covered Species is impossible under the Proposed Action, the Applicant has sought to avoid and minimize the risk of collisions to the greatest extent practicable by making the turbines less attractive, more visible, and/or more likely to be avoided by birds and bats. These measures include:

- Employing relatively few turbines situated in two single rows, rather than a large number of staggered turbines or multiple rows;
- Using "monopole" steel tubular towers for turbines, rather than lattice towers, to virtually eliminate perching and nesting opportunities. The tubular towers may also reduce collision risk because they are considerably more visible;
- Utilizing a rotor with a rotational speed (11-20 rpm) that makes the rotor visible during operation;
- Choosing a site in proximity to existing electrical transmission lines to reduce the length of overhead transmission line needed from the project to the interconnect location;
- Selecting a site in proximity to the existing KWP facility so key infrastructure can be shared, thereby minimizing the need for new disturbance and development. Also, the considerable body of data that has been collected on endangered species at the KWP site informs KWP II site selection and avoidance/minimization measures, as well as likely mitigation requirements;
- Placement of all new power collection lines underground as far as practicable to minimize the risk of collision with new wires; Overhead collection lines will be fitted with marker balls to increase visibility. All overhead collection lines will be spaced according to Avian Power Line Interaction Committee (APLIC) guidelines to prevent possible electrocution of native species. Species most at risk at those likely to perch on power poles or lines (APLIC, 2006). Only one species is identified to be at risk at KWP II, the Hawaiian short-eared owl. Using the barn owl as a surrogate species, the horizontal

⁶ Examples include GE's 2.5-MW series and 3.6-MW machines (which have overall heights reaching up to 500 feet) and the 3.0-MW Vestas V90, whose overall height is about the same as that of the large GE Unit.

⁷ GE has modified its Model 1.5se design since KWP was constructed. The new design has a tower height of 212 feet and the same rotor diameter (231 feet), for a total height of 328 feet. In comparison, the total height of the existing GE 1.5se turbines at KWP I is 296 feet (90 m).

⁸ Because the ownership of KWP II is different from that of KWP, the exchange/sharing of parts and services would be done on a commercial basis, but the co-location of the two sets of wind generators and support equipment will greatly facilitate this and will reduce overall costs.

spacing will be more than 20 in (51 cm) to accommodate the wrist-to-wrist distance of the owl. If a vertical arrangement is chosen, a vertical spacing of more than 15 inches (38 cm, head-to-foot length) will be used (APLIC 2006). Any jumper wires will be insulated;

- Placement of the overhead power collection line will be as close to the existing MECO transmission line as practicable (see Figure 1.3). These lines will fall within the height range of the existing transmission lines (currently arranged as a vertical array of four lines) and also parallel their alignment across the gulch to reduce the cumulative cross sectional area presented. Marker balls which will be present on both lines should increase their visibility to Covered Species and minimize risk of collisions.
- Designing and installing the site substation and interconnect to MECO's transmission lines using industry-standard measures to reduce the possibility of wildlife electrocutions;
- Installing unguyed met towers as opposed to guyed met towers to avoid potential for avian collision with guy wires.
- Restricting construction activity to daylight hours as much as possible during the seabird breeding season to avoid the use of nighttime lighting that could be an attraction to seabirds;
- Requesting FAA endorsement of a minimal lighting plan to reduce the likelihood of attracting or disorienting seabirds;
- Having minimal on-site lighting at the operations and maintenance building and substation, using fixtures that will be shielded and/or directed downward and only utilized on infrequent occasions when workers are at the site at night (these three lighting measures will be used not only to minimize impacts to wildlife, but also to reduce the visual impact as viewed from local communities at night);
- Conducting pre-construction surveys for nēnē and their nests prior to roadway and site clearing and construction to identify and avoid harming or harassing (as defined under the ESA) any active nests, eggs, young, or adults; an improved survey protocol based on the successful model implemented at KWP will be used for this HCP (Appendix 12);
- Implementation of a daily search protocol during construction to minimize the risk of direct impacts to nene and their nests (Appendix 12);
- Should construction begin and nēnē and/or a nest(s) are subsequently discovered, designated environmental personnel will be immediately notified and construction activities will be modified or curtailed until appropriate measures are implemented, in consultation with DLNR and USFWS, which will reduce or eliminate adverse risk to nene or their nests;
- A speed limit of 10 mph will also be enforced to reduce possible vehicular collisions with nēnē and the Hawaiian short-eared owl.

4.3.2 USFWS Guidelines

While wind energy has been utilized for centuries, it has expanded rapidly rather recently in the U.S. and worldwide with advances in technology and increased interest in renewable and alternative energy sources. In recognition of the growing wind energy industry in the United States, the USFWS has prepared "*Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines*" (USFWS 2004) available through the USFWS website, <http://www.fws.gov>. The guidelines were published simultaneously with a Federal Register Notice of Availability and request for comments on the guidelines.

After reviewing the comments received, the Secretary of the Interior established a Wind Turbine Guidelines Advisory Committee to provide advice and recommendations to the Secretary of the Interior on developing effective measures to avoid or minimize impacts to wildlife and their

habitats related to land-based wind energy facilities. To date, no updates to the *Interim Guidelines* have been released, and compliance with them is considered voluntary. Nonetheless, the Applicant believes that these guidelines provide several substantive recommendations that are relevant and applicable to the proposed wind energy generation facility.

[Table 4.1](#) below lists the recommendations from the *Interim Guidelines* relating to site development and turbine design and operation and discusses how the Applicant plans to comply with these recommendations. It should be noted that these recommendations relate to all wildlife, whether or not they are protected under the ESA or MBTA, and the benefits of following these recommendations, where applicable, extend beyond the implementation of this HCP.

Table 4.1 Compliance of the Proposed KWP II Facility with the USFWS Interim Voluntary Guidelines for Wind Projects (USFWS 2004).

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
Avoid placing turbines in documented locations of any species of wildlife, fish, or plant protected under the Federal Endangered Species Act.	There are no locations on Maui that are both: (a) suitable for a financially viable wind energy generation facility and (b) unlikely to be visited by listed species. Data from the existing KWP facility indicates that occurrence of the Covered Species on the site is relatively low, and take is commensurately at or below the Baseline Level identified in the KWP HCP. The proposed KWP II project minimizes habitat disturbance by sharing key infrastructure with KWP and likewise incorporates measures to avoid and minimize risk to Covered Species as much as possible while still meeting the basic project purpose.
Avoid locating turbines in known local bird migration pathways or in areas where birds are highly concentrated, unless mortality risk is low (e.g., birds present rarely enter the rotor-swept area). Examples of high concentration areas for birds are wetlands, State or Federal refuges, private duck clubs, staging areas, rookeries, leks, roosts, riparian areas along streams, and landfills. Avoid known daily movement flyways (e.g., between roosting and feeding areas) and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.	This recommendation has been followed as much as practicable while still meeting the basic project purpose. Survey data collected to date has shown that birds do not occur in the area in high concentrations.
Avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.	This recommendation has been followed, based on the little information available on Hawaiian hoary bats. The species is not known to hibernate or occur colonially. While a few bats have been confirmed to fly through the project area, no habitat considered suitable for roosting or breeding is present in or adjacent to the project area.
Configure turbine locations to avoid areas or features of the landscape known to attract raptors (hawks, falcons, eagles, owls). For example, Golden Eagles, hawks, and falcons use cliff/rim edges extensively; setbacks from these edges may reduce mortality. Other examples include not locating turbines in a dip or pass in a ridge, or in or near prairie dog colonies.	This recommendation has been followed, to the extent that it is applicable, by situating the turbines on high ground, outside of the Manawainui Gulch and Malalowaiaole Gulch where most Hawaiian short-eared owl activity has been observed; Much like what is observed at KWP, Hawaiian short-eared owls at KWP II are expected to be observed occasionally flying over grasslands of the proposed wind farm, but at low risk of collision with the turbines and associated structures (see section 3.7).

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
Configure turbine arrays to avoid potential avian mortality where feasible. For example, group turbines rather than spreading them widely, and orient rows of turbines parallel to known bird movements, thereby decreasing the potential for bird strikes. Implement appropriate storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species (e.g., Sage Grouse).	Turbines have been arranged as closely as feasible, given wind resource and terrain considerations, and in a linear fashion that is generally parallel to the direction of birds moving to and from the ocean. No potentially attractive water features will be constructed for the project.
Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated, and away from areas of intact and healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.	The majority of the natural environment in the project area has been previously disturbed by wildfires, pasturing and grazing uses. Existing areas of native cover types are fragmented and interspersed with disturbed, non-native dominated cover. Nēnē do utilize open areas and rock outcrops, and the Applicant has micro-sited the proposed WTGs so as not to disturb the features that are most attractive to nēnē.
Avoid placing turbines in habitat known to be occupied by prairie grouse or other species that exhibit extreme avoidance of vertical features and/or structural fragmentation. In known prairie grouse habitat, avoid placing turbines within five miles of known leks (communal pair formation grounds).	Not applicable - no such species occur in the area.
Minimize roads, fences, and other infrastructure. All infrastructure should be capable of withstanding periodic burning of vegetation, as natural fires or controlled burns are necessary for maintaining most prairie habitats.	This recommendation will be followed. A Wild Land Fire Contingency Plan is in place for KWP and will be administered at KWP II as well (note that controlled burn and prairie considerations are not applicable).
Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. For example, avoid attracting high densities of prey animals (rodents, rabbits, etc.) used by raptors.	This recommendation will be followed. Revegetation of disturbed areas and other habitat improvement measures will be coordinated with DLNR staff.
Reduce availability of carrion by practicing responsible animal husbandry (removing carcasses, fencing out cattle, etc.) to avoid attracting Golden Eagles and other raptors.	This recommendation is not applicable as Golden Eagles and other raptors are not species of concern in the vicinity of the project.
Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching and nesting. Avoid use of guy wires for turbine or met tower supports. All existing guy wires should be marked with recommended bird deterrent devices (Avian Power Line Interaction Committee 1994).	This recommendation has been, and will continue to be followed. Tubular towers are being utilized for turbines. The permanent met tower will be unguyed.
If taller turbines (top of the rotor-swept area is >199 feet above ground level) require lights for aviation safety, the minimum amount of pilot warning and obstruction avoidance lighting specified by the Federal Aviation Administration (FAA) should be used (FAA 2000). Unless otherwise requested by the FAA, only white strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. Solid red or pulsating red incandescent lights should not be used, as they appear to attract night-migrating birds at a much higher rate than white strobe lights.	KWP II LLC is working with the FAA to apply a minimal lighting scheme such as that which has been implemented at KWP. Other on-site lighting will be minimal, shielded and used infrequently.

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
Where the height of the rotor-swept area produces a high risk for wildlife, adjust tower height where feasible to reduce the risk of strikes.	This recommendation is generally not applicable in that the risk of strikes is not demonstrably related to the height of the rotor-swept area. However, the proposed 65-meter towers are the shortest that GE produces for its 1.5 MW machines.
Where feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of the Avian Power Line Interaction Committee (1994, 1996, 2006) for any required aboveground lines, transformers, or conductors.	This recommendation is being followed; all new power lines will be placed underground where feasible. APLIC guidelines for overhead collection lines have been followed.
High seasonal concentrations of birds may cause problems in some areas. If, however, power generation is critical in these areas, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates for specific sites. Where feasible, turbines should be shut down during periods when birds are highly concentrated at those sites.	This recommendation is not applicable as there is no documented seasonal concentration of birds. Though seabirds have been documented passing through the area, their numbers are low compared to other locations on Maui. Nēnē are present on site year round (Section 3.8.3.3) and flight activity does not vary with time of day. Furthermore, results of on-going acoustic monitoring of bats at KWP and KWP II indicate low levels bat activity on site between April to November and no activity between December to March (Appendix 4).
When upgrading or retrofitting turbines, follow the above guidelines as closely as possible. If studies indicate high mortality at specific older turbines, retrofitting or relocating is highly recommended.	This recommendation is not applicable to the current project as it will be a new facility.

5.0 ASSESSMENT OF POTENTIAL IMPACTS

5.1 ASSESSMENT OF POTENTIAL IMPACTS TO COVERED SPECIES

Generation of electrical energy from wind is a renewable, clean, environmentally friendly technology. It reduces greenhouse gas emissions and water use in electricity generation. At the same time, the potential for wind energy turbines to adversely affect birds and bats is well-documented in the continental United States (e.g., Horn et al. 2008, Kunz et al. 2007, Kingsley and Whittam 2007, Kerlinger 2005, Erickson 2003, Johnson et al. 2003a, 2003b).

5.1.2 Impacts to Birds

Erickson et al. (2001) estimated that an average of 2.19 bird fatalities occur per wind turbine annually in the United States. Based on 12 wind projects in the U.S., the National Wind Coordinating Collaborative (2004) estimated an average annual avian fatality rate of 2.3 birds per turbine. Though avian fatality rates differ by region, projects in California presently account for the highest wind-related avian mortality in North America. Certain types of birds in certain settings seem to have a higher risk of collision with wind energy facilities than others. When abundant in open country, as in California, raptors (hawks, eagles, falcons and owls), have had comparatively high fatality rates, though passerines as a class generally comprise the majority of fatalities at wind facilities nationwide (Erickson et al. 2001, NWCC 2004, Kingsley and Whittam 2007). Although some impacts to avian species may occur as a result of habitat alteration and disturbance or operation of vehicles, most fatalities at wind facilities are attributed to collisions with wind turbine rotors, met towers, or guy wires (Kerlinger and Guarnaccia 2005).

Numbers of avian fatalities at wind energy facilities are very low compared to the numbers of fatalities resulting from some other human-related causes. Known sources of anthropogenic bird losses outside of wind energy sites include: lighted buildings, windows, communications towers, powerlines, smokestacks, vehicles, cat predation, pesticides, and hunting (Podolsky et al. 1998, Erickson et al. 2001, Martin and Padding 2002, Woodlot Alternatives, Inc. 2003, Federal Register 2004, Mineau 2005). Mortality from these other sources is many orders of magnitude higher than that which occurs at wind facilities.

5.1.3 Impacts to Bats

The number of bat fatalities at wind energy facilities has often exceeded the number of avian fatalities. Studies in the continental U.S. have shown that annual fatality rates vary by region with an average of 1.2 bat fatalities per turbine in the Pacific Northwest and Rocky Mountains, 1.7 bat fatalities per turbine (0.1 - 7.8 bats per turbine) in the Upper Midwest, and as many as 46.3 bat fatalities per turbine (range 15.54 - 69.6 bats per turbine) in certain areas of the eastern U.S. (Johnson 2005). Differences are likely due to differences in local habitat conditions and population sizes of the most susceptible species. Facilities studied in the eastern U.S. where fatalities are highest are primarily located along forested ridge tops as opposed to open areas, and where migratory tree-roosting species are most numerous. Geographic and topographic differences may also be factors. Most of the recorded bat fatalities in the U.S. (83.2%) are members of migratory tree-roosting species. Hoary bats, of which the Hawaiian hoary bat is a non-migratory (in the classic sense) subspecies, are the most frequently (45.5%) recorded fatalities (Johnson 2005, Cryan and Brown 2007).

Available evidence indicates that bat mortality at continental U.S. wind facilities peaks in late summer and fall, coinciding with mating and migration. Increased bat fatalities also tend to occur during periods of low wind speed (< 13.5 mph or 6 m/s) and passing weather fronts (Arnett et al. 2008). In contrast, observed bat collision mortality during the breeding season is rare (Johnson et al. 2003b). Similar to birds, bats are also known to collide with high, man-made structures (Johnson 2005).

The high number of fatalities of migratory tree-roosting bats at wind energy facilities has stimulated a cooperative research effort to explore how and why bats contact turbines (Arnett et al. 2008). Several possible explanations have been generated. Research has suggested that

some fatalities may result from mating behaviors that center on the tallest trees in a landscape (Cryan 2008). Some have suggested that some bats may be attracted to audible sound, ultrasound, and movement of wind turbine structures (Horn et al. 2008). However, research on the sound emissions of various turbines found that ultrasonic emissions attenuated at short distances from the turbine and there was no evidence of unusual ultrasonic emissions that would attract bats (Szewczak and Arnett 2006). Other theories speculate that migratory behavior, such as stopovers, are responsible for observed fatality rates (Johnson 2005, Cryan and Brown 2007) or that forest edges produced by access roads create favorable foraging habitat (Horn et al. 2008). Baerwald et al. (2008) documented that some bats killed at wind turbines suffered from barotrauma, i.e., pulmonary hemorrhaging caused by a rapid reduction in air-pressure, such as occurs behind moving turbine blades rather than direct collision with blades.

5.2 ESTIMATING PROJECT-RELATED IMPACTS

In the state of Hawai'i, wind-powered generation facilities are relatively new; thus, few wildlife monitoring impact studies have been conducted to document the direct or indirect impact of wind energy facilities on particular species. However, post-construction monitoring to document downed wildlife has been conducted at the KWP facility since operations began in June 2006 (Kaheawa Wind Power 2008b, 2008c) and suggest that avian mortality resulting from the proposed KWP II project may occur at a lower rate than has occurred at facilities in the continental U.S. This information is based upon the best available insight into the potential risk to wildlife posed by WTGs in the Downroad KWP II project area, as well as the take estimates made for the KWP project. No Covered Species were found downed or dead during the first year of construction and operation of the KWP project (Kaheawa Wind Power 2007a, 2007b). During the second and third years of monitoring, KWP documented **observed** direct take of three listed species – one adult Hawaiian petrel, three full-grown nēnē, and one Hawaiian hoary bat (Kaheawa Wind Power 2008b, 2008c, **Kaheawa Wind Power 2009**). Rates of adjusted take (i.e., adjusted for searcher efficiency, scavenging and indirect take) at KWP fall within "Baseline" or "Lower" ranges as described in the KWP HCP (Kaheawa Wind Power 2006). Other documented fatalities include two ring-necked pheasants, **three black francolins, two gray francolins, one barn owl, a white-tailed tropic bird and one Hawaiian short-eared owl.**

Construction and operation of the KWP II project would create the potential for the Covered Species to collide with the WTGs, temporary and permanent met towers, overhead collection lines and cranes used for construction of the turbines. Estimating the potential for each Covered Species to collide with these project components (i.e., "direct take") was done using the results of the on-site surveys, information about the proposed project design, and the results of post-construction monitoring at the adjacent KWP facility. The fatality estimate models developed for KWP and used for KWP II incorporated rates of species occurrence, observed flight heights, encounter-rates with turbines and met towers, and estimated ability of birds to avoid project components. For KWP II, the assumed ability of Hawaiian petrels and Newell's shearwaters to avoid turbines was varied in the models to create a range of probabilities of mortality for each species on an annual basis. The results of mortality monitoring conducted to date at KWP were also used in the models to identify the corresponding suggested turbine avoidance rate exhibited by the seabirds. Range of expected mortality coincides with the amount of "direct take" expected from construction and operation of the KWP II facility.

In addition to "direct take," collision with project components can also result in the "indirect take" of Covered Species. It is possible that adult birds directly taken during certain times of the year could have been tending to eggs, nestlings, or dependent fledglings, or that adult bats could have been tending to dependent juveniles. The loss of these adults could then also lead to the loss of eggs or dependent young. Loss of eggs or young would be "indirect take" attributable to the proposed project. Methods for determining indirect take are described in detail in Section 5.2.1.

Estimated annual mortality resulting from the KWP II project for each of the Covered Species is provided in the following sections. Included for each species is an estimate of the amount of indirect take expected to occur based on the expected level of direct take. As discussed in Section 7.2 (Monitoring), the "total direct take" attributed to the KWP II project will be the sum of observed direct take (actual individuals found during post-construction monitoring) and

unobserved direct take based on searcher efficiency and scavenging trial results. The latter will account for individuals that may be killed by collision with project components but that are not found by searchers for various reasons, including vegetation cover and scavenging. The equations discussed are presented below:

$$\text{Total Direct Take} = \text{Observed Take} + \text{Unobserved Take}$$

$$\text{Total Adjusted Take} = \text{Total Direct Take} + \text{Indirect Take}$$

“Total direct take” will be calculated based on the best available estimator at the time. An example of an accepted estimator, proposed in Huso (2008) is presented below.

$$\hat{m}_{ij} = \frac{c_{ij}}{\hat{r}_{ij} \hat{p}_{ij} \hat{e}_{ij}}$$

where

- m_{ij}** Estimated mortality
- r_{ij}** Estimated proportion of carcasses remaining after scavenging
- e_{ij}** Effective search interval
- p_{ij}** Estimated searcher efficiency
- c_{ij}** Observed take

A detailed protocol of how monitoring will take place at KWP II (including methods of quantifying searcher efficiency and scavenging rates) is provided in Section 7.2 and Appendix 2.

Sections 5.2.2 through 5.2.5 identify anticipated levels of direct and indirect take for each of the Covered Species. Due to the very low observed levels of activity at KWP II for most of the Covered Species, the mortality modeling provides very low estimated rates of direct take. For most species, based on the modeling, annual mortality is expected to average less than one individual per species per year over the life of the project. In order to account for the stochasticity of take over time, where take in any given year may be higher or lower than the expected long-term average, 1-year, 5-year, and 20-year take limits are proposed (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and not more than ten individuals for 20 years). Short-term take limits (1-year and 5-year limits) also provide benchmarks for the monitoring of take and will enable mitigation efforts to be tailored to respond to more immediate events. Twenty-year limits, however, are believed to be a better reflection of the long-term amount of take expected.

Post-construction monitoring will be used to determine “total direct take” attributable to the project on an annual basis. “Total direct take” and “indirect take” of each Covered Species will be identified as “Baseline,” “Lower,” or “Higher”. The amount requested to be authorized by the ITP and ITL will cover the “total adjusted take”, essentially the sum of “total direct take” and “indirect take” for the Baseline and Higher level. For each species, the annual **Baseline** level of take was estimated based on the expected average annual mortality, rounded up to the nearest whole integer, and then adjusted to account for expected levels of unobserved direct take. For example, modeling suggests nēnē mortality will occur at an average rate of approximately 0.45 adults per year. To identify the annual Baseline level of take requested to be authorized, this was first rounded up to one adult per year (i.e., almost 2x). Then, based on assumptions concerning unobserved direct take, it was expected that the discovery of one nēnē mortality in a given year would lead to an assessment of total direct take for that year of two nēnē. So, while the modeling suggests that nēnē mortality will occur at a rate of roughly one adult bird every 2 years, because it cannot be known if or in what years mortality will occur and because of assumptions concerning unobserved direct take, it is necessary to have the annual Baseline take authorization for nēnē

allow the total direct take of a minimum of two adult birds in any given year. In addition, to allow for the uneven distribution of take over time, it is possible for two birds to be taken in any one year, followed by no take in the subsequent years. Hence, an observed take of two birds in one year is possible and likely to be rounded up to a total direct take of three to four birds after all the adjustments have been applied. Therefore, for some of the Covered Species, a direct take of up to four birds is requested for the *annual* Baseline level of take. The 5-year and 20-year Baseline levels, being of a longer-term duration, however, are expected to more closely reflect the expected *annual average* mortalities.

The **Lower** rate of take will be deemed to be occurring if the total adjusted rate of take is less than 50% of the **requested Baseline** rate of take expected over a **5- or 20-year** period. For example, if the Baseline requested take over a 20-year period is 20 adults and 20 chicks, a lower rate of take over a 5-year period would be less than 2 adults and 2 chicks ($=20 \text{ adults or chicks} / 20 \text{ years} \times 5 \text{ years} \times 0.5$) and 10 adults and 10 chicks over the 20-year duration of the project.

A **Higher** rate of take would be that which exceeds the authorized Baseline rate. A Higher rate of take is 1.5 times the Baseline rate of take over a **5- or 20-year** period. Because of expected annual variability in actual rates of take, this HCP proposes that different levels of take be authorized. Any take occurring in excess of the one-year, 5-year, and 20-year Baseline limits could be considered a "Higher" rate. However, it would be possible for rates of take to occur so unevenly that take could qualify as "Higher" in one year and "Baseline" over the corresponding 5-year term. Therefore, Higher rates of take identified over 5-year and 20-year terms will be used to make adjustments to mitigation efforts because they will have incorporated some averaging of annual variability, while Higher rates measured over one-year terms will be used as "early warnings" that adjustments to mitigation efforts may become necessary and to spur investigation into why a Higher rate of take occurred and whether steps can be taken to reduce future take. If post-construction monitoring indicates that take has exceeded the 5-year or 20-year Baseline take limit for any species, the Applicant **would be determined to be at a Higher rate of take and would** re-initiate consultation with DLNR and USFWS to implement adaptive management strategies.

5.2.1 Indirect Take

For the purposes of this HCP, an assessment of indirect take will be added to any observed direct take based on the presumed breeding status of the taken individual and potential productivity as discussed below.

Hawaiian petrel, Newell's shearwater, and Hawaiian hoary bat each have a well defined breeding season. For these three species, breeding status will be assigned following the general principles identified below:

- If an adult is found during breeding season, and if an estimate of the average breeding rate of the species (percent of adult population breeding in a given year) is available, the average population breeding rate will be used to determine the probability that the adult was breeding;
- If an adult is found during breeding season, and if an estimated breeding rate is not available for the species, the adult will be assumed to have been breeding;
- If an adult is found outside of the breeding season, the adult will be assumed to have been non-breeding;
- Immatures will be assumed to be non-breeding regardless of season;
- If age cannot be determined, an individual will be assumed to have been an adult of breeding age.

The nēnē has an extended breeding season (August to April), although the majority nest from October to March. In the case of assigning breeding status to the nēnē, the following principles are applied:

- If an adult is found during the months of October through March, the average population breeding rate (60%) will be used to determine the probability that the adult was breeding;
- If an adult is found in April, August, or September, it will be assumed there was a 25% chance the bird had been actively breeding;
- If an adult is found in May, June, or July, the bird will be assumed to have been non-breeding;
- Immatures will be assumed to be non-breeding regardless of season;
- If age cannot be determined, an individual will be assumed to have been an adult of breeding age.

Potential productivity ranges widely amongst the Covered Species. Newell's shearwaters and Hawaiian petrels are expected to produce no more than one young per pair per year. Nēnē produce average clutches of three to five eggs. While not all young hatched from a clutch of eggs can be expected to survive to fledging age, much less adulthood, if an incubating female bird is killed by collision with a turbine, that fatality may be held indirectly responsible for the loss of the eggs that were viable at the time of collision. On the other hand, if a female is killed during the time it is tending to recently fledged young, a reasonable expectation would exist that the number of fledglings lost because of loss of parental care would be fewer than the average clutch size of that species because of possible pre-collision natural losses to predation, disease, starvation, etc. that typically accrue through the breeding period.

The probability of the Covered Species colliding with WTGs also changes with time of year and/or breeding status. For example, Newell's shearwaters and Hawaiian petrels have potential to collide with turbines only during the breeding season because during non-breeding periods they remain at sea. Hawaiian hoary bats may preferentially reside at higher elevations during non-breeding periods. Nēnē become territorial during the breeding and molting season (when they become flightless) while caring for goslings. Thus, nēnē are very unlikely to collide with turbines and related structures while nesting or attending to goslings.

Finally, assessments of indirect take must consider parental contributions to care of the eggs and/or young. Male Hawaiian hoary bats take no role in raising of young, so death of a male bat cannot lead to indirect take. Males of some of the bird species do contribute significant effort to raising of young, so if a female of such a species were to be killed during the breeding season, the male of the pair may be capable of successfully raising some of their young, especially if the mortality were to occur when the young were closer to fledging age.

The following sections provide assessments of potential impacts to each of the Covered Species and identify estimates of the anticipated rates of take for each. The amount of annual take requested to be authorized in the ITP and ITL for each Covered Species is divided into two categories. One category is the number of individuals directly taken and the other consists of the number of individuals that will be assumed to be indirectly taken in terms of eggs, juveniles, or fledglings.

5.2.2 Hawaiian Petrel

5.2.2.1 Risk of Hawaiian Petrel Collision with WTGs

KWP is the only operating wind energy generating facility in Hawai'i where potential mortality of Hawaiian petrels and Newell's shearwaters is consistently being studied. KWP and KWP II have commissioned several independent studies using ornithological radar to estimate the movement rates for Hawaiian petrels and Newell's shearwaters through the site during the roughly eight-month spring-fall breeding season when these birds are present near Kaheawa Pastures. The earlier of these (Cooper and Day 2004; Day and Cooper 1999, Sanzenbacher and Cooper 2009)

focused on the KWP project area. KWP biologists also independently conducted a radar study in the Summer and Fall of 2006. The most recent and comprehensive study was performed in Summer and Fall 2009 at the Downroad portion of the proposed KWP II project area (Cooper and Day 2009).

The primary objective of the 2009 Summer and Fall studies was to document movement rates of Hawaiian petrels and Newell's shearwaters over the proposed KWP II project area during the nesting and fledging period. The Cooper and Day (2009) report is provided as Appendix 3 and 13. Summer and Fall movement rates were used to derive estimated annual fatality rates of petrels/shearwaters at the proposed turbine tower locations.

Fatality estimates were modeled for different avoidance rates. Avoidance rates represent the proportion of birds that will actively avoid turbines upon encountering them. Cooper and Day (2009) used avoidance rates of 90%, 95% and 99% because previous studies have indicated a high rate of avoidance of power lines and communication towers for these species (Cooper and Day 1998, TetraTech 2008). It is expected that this type of avoidance behavior will also enable the species to effectively avoid WTGs a large majority of the time (Cooper and Day 2009). For the Hawaiian petrel, fatality estimates range from 0.015 – 0.20 birds per turbine per year, or 0.21 to 2.73 birds per year for all 14 turbines combined based on 90%, 95% and 99% avoidance rates.

The average annual total direct take of Hawaiian petrels at KWP after 3.5 years of operation is approximately 0.5 birds/year. Using this data it is possible to "work backwards" through the modeling originally developed for KWP to determine which avoidance rate leads to the rate of direct take observed at KWP (Table 5.1). The Fall 2008 and Summer 2009 passage rates were not incorporated in this model, as in reality, most pre-construction models will only have one year of data to draw from. It is also not known how the presence of turbines would change the passage rates of seabirds in the area, once they are constructed. The 95% avoidance rate predicts mortality at more than twice the observed rate (1.08 vs. 0.5), and the 99% avoidance rate results in an underestimate (0.22 vs. 0.5). A 97.5% avoidance rate was found to result in a predicted mortality closest to the rate of direct take observed to date at KWP. Therefore, for the purposes of estimating fatality rates at KWP II, a 97.5% avoidance rate was used with the seabird fatality modeling from Cooper and Day (2009). This resulted in an estimated fatality rate for Hawaiian petrels of 0.049 birds/turbine/year or 0.69 birds/year for all 14 turbines combined.

Table 5.1 Predicted Mortality Rates of Hawaiian Petrels at KWP with Varying Avoidance Rates.

Avoidance rates from modeling	Predicted annual mortality for site*	Source
50% avoidance rate	10.77	Cooper and Day 2004
95% avoidance rate	1.08	Cooper and Day 2004
97.5% avoidance rate	0.54	extrapolated from Cooper and Day 2004
99% avoidance rate	0.22	Cooper and Day 2004

* Annual direct take at KWP is 0.5 birds/year.

Fatality estimates were also modeled for one permanent un-guyed 213-foot (65-m) lattice met tower. This modeling predicts an average mortality of 0.007 to 0.073 Hawaiian petrels/met tower/year based on 90%, 95% and 99% avoidance rates. No met tower fatalities have been recorded at KWP. Given the very low rate of predicted met tower mortality, no adjustments to met tower avoidance rates were made in the modeling in response to the KWP monitoring results. Therefore, for the purposes of estimating fatality rates at KWP II, the 95% avoidance level was chosen, resulting in an estimated fatality rate for Hawaiian petrels at 0.036 birds/year/tower.

5.2.2.2 Other Direct Take of Hawaiian Petrels

In addition to collisions with turbines and met towers, some limited potential exists for Hawaiian petrels to collide with cranes during the construction phase of the project. Cranes used during construction are typically comparable in height to the turbine towers (Kaheawa Wind Power, LLC 2006). However, the construction phase is expected to last six to eight months, with cranes on-site for only three to four months, and during that period, they will not always be vertical. The potential for Hawaiian petrels to collide with construction cranes is considered to be negligible given the brevity of the construction period and the low occurrence rate of the species on-site.

A crane will permanently be available for KWP II (probably shared with KWP) for maintenance purposes and will be present at KWP II as needed. Except for emergencies, this crane would be used only during the day and stored in its horizontal position at ground level when not in use and at night. Consequently, this crane is not considered to pose a collision threat to Hawaiian petrels. No Hawaiian petrels collided with cranes used to construct KWP.

Potential also exists for Hawaiian petrels to collide with the 1225 foot (374 m) section of the collection line that crosses the gulch at the upper portion of the project area (see Section 1.4 for details). This line will be mounted on poles approximately 60 - 90 feet (18 - 25 m) above ground level and will be a maximum of 340 ft (104 m) above the deepest part of the gulch. Precautions to minimize collisions include installing marker balls on the collection line to enhance visibility and placing the collection line in close proximity to an existing transmission line of the same height that also crosses the gulch and is similarly marked (see Section 4.3.1). Observation of Hawaiian petrels on Kauai by Day et al. (in review) suggests that collision avoidance rates of powerlines by Hawaiian petrels is very high (207 observed birds with 40 birds exhibiting collision avoidance responses and zero resultant collisions). Thus the collision rate of Hawaiian petrels with overhead collection lines is considered very small and assigned a value of 0.1 birds/year (one bird every ten years) given the low occurrence rate of species on the site, their avoidance capabilities and the minimization measures that will be employed.

Construction or maintenance vehicles have potential to strike downed petrels (birds already injured by collision with turbines or towers) while traveling project roads. Project personnel will be trained to watch for downed petrels and other wildlife and speed limits (10 mph or 16 kph) will be enforced to minimize potential for vehicular strikes to result in death of birds that otherwise might have been able to be rehabilitated. Despite this, it is assumed that day-to-day maintenance of the wind facility may very occasionally result in the fatality of a petrel. This source of potential mortality does not result in an increase in the amount of direct take expected from the proposed project because such birds would be those not avoiding the WTGs or met tower and, thus, have been accounted for in the mortality modeling.

Therefore, for this HCP, it is projected that take of Hawaiian petrels as a result of collision with project components and vehicle strikes will occur at the average rate of 0.83 petrels/year (0.69 (turbines) + 0.04 (met tower) + 0.1 (collection line) = 0.83).

5.2.2.3 Indirect Take of Hawaiian Petrel

Adult and immature birds have potential to collide with turbines and associated structures while commuting between nesting and feeding grounds during the pre-laying period (March to April) and incubation or chick-feeding periods (May through October). Indirect take accounting for possible loss of eggs or chicks would be assessed to any direct take of adult Hawaiian petrels occurring during the breeding period of May through October, but would not be assessed if direct take of this species occurs during the pre-laying period or at other times of year. The risk of collision outside the pre-laying period or breeding season is considered minimal as these birds do not return to land during that time.

Potential for survival of offspring following a collision appears dependent upon the time at which the parent is lost. Both parents alternate incubating the egg (May-June), allowing one or the other to leave the colony to feed. Therefore, during the egg-laying/incubation period it is

expected that both parents are essential for the successful hatching of the egg (Simons 1985). Both parents also contribute to the feeding of chicks. Chicks are fed 95% of the total food they will receive from their parents within 90 days of hatching (Simons 1985). Because hatching generally occurs in late June, chicks should have received 95% of their food by the end of September. After this time, it is likely that many chicks could fledge successfully without further parental care as some chicks have been seen to have been abandoned by their parents up to three weeks prior to fledging (Simons 1985). Consequently, it is considered probable that after this time many chicks would also be capable of fledging if subsequent care was provided by only one parent. Based on this, for the purposes of this HCP and assessing indirect take, both parents are considered essential to the survival of a Hawaiian petrel chick through September, but it is assumed that a chick has a 50% chance of fledging successfully if adult take occurs in October.

Not all adult Hawaiian petrels visiting a nesting colony breed every year. Simons (1985) found that 11% of breeding-age females at nesting colonies were not breeding. Most non-breeding birds and failed breeders leave the colony for the season by mid-August (Simons 1985). Therefore, it appears there would be an 89% chance that an adult petrel taken from May through August was actually breeding, but nearly a 100% chance that birds taken in September or October would be tending to young. Based on the above life history parameters and as identified in [Table 5.2](#) below, indirect take would be assessed at the rate of 0.89 eggs or chicks per adult taken between May and August, 1.00 chick per adult taken in September, and 0.50 chick per adult taken in October (life history data presented can also be found in Appendix 7).

Table 5.2 Calculation of Indirect Take for Hawaiian Petrel

Hawaiian petrel	Season	Average no. of chicks per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Adult	Mar - Apr	--	0	--	0.00
Adult	May - Aug	1	0.89	1.0	0.89 eggs/chicks
Adult	Sept	1	1.00	1.0	1.00 chick
Adult	Oct	1	1.00	0.5	0.50 chicks
Adult	Nov - Apr	--	0.00	--	0.00
Immature	All year	--	0.00	--	0.00

5.2.2.4 Estimating Total Take for the Hawaiian Petrel

The estimated average mortality rate of Hawaiian petrel allowing for potential collisions with WTGs and permanent met towers and adjusted for potential for collection line strikes is 0.83 petrel/year, or essentially one petrel per year. Based on estimated rates of direct and indirect take, take of this species resulting from project operations is expected to average no more than approximately two birds per year (0.83 adult/year + maximum of 0.83 chick/year = 1.66 birds). Because of assumptions concerning unobserved direct take, any one Hawaiian petrel found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one, with total direct take then likely to be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates). Given that a direct take averaging about one petrel per year is expected at KWP II, this will lead to an assessment of total direct take for that year of greater than one that likely would be rounded up to two birds.

Moreover, as take may be distributed unevenly over the years (see Section 5.2), the Applicant proposes that the ITP and ITL allow for a total direct take of up to four Hawaiian petrels and the indirect take of three chicks for any given year for the duration of the project (see below for calculations on indirect take). A 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be

authorized as three individuals in any given year but not more than five individuals total every 5 years and 15 adults every 20 years). See section 5.2 for a detailed explanation.

Birds “taken” through assessment of “unobserved direct take” will be assumed to have been of the same age and breeding status as the individual that was found. As the amount of indirect take assessed is dependent upon when the direct take occurs during the breeding season, for the purposes of calculating the expected indirect take, it was assumed that direct take has an equal probability of occurring anytime between March and November. This period includes the pre-laying period (March to April), the breeding season (May to October) and fledging period (November). It is expected that only adults will be take from March to October and only fledglings will be taken in November. This distribution of fatality over the breeding season (nine months long) was used to determine the expected amount of indirect take. For example, for a total direct take of 18 petrels, a total direct take of four individuals would be expected to occur from March to April ($=18 \times 2 \text{ months}/9 \text{ months}$) over the life of the project (Table 5.3). Table 5.3 shows the expected distribution of direct take over the breeding season and the indirect take that would be subsequently assessed (derived from Table 5.2) for the **Baseline** requested take levels.

Table 5.3 Allocation of Indirect Take for Hawaiian Petrel for the Requested Baseline Level of Take

Hawaiian petrel	Adult (March-April)	Adult (May-Aug)	Adult (Sept)	Adult (Oct)	Fledgling (Nov)	Total
Direct take	4	8	2	2	2	18
Indirect take	0.0	7.1	2.0	1.0	0.0	11 (=10.1)

Expected rates of take and rates of take requested to be authorized by the ITL and ITP through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as “Lower,” and “Higher”.

Expected Rate of Take

Annual average	0.83 adults/immatures and 0.83 chicks/eggs 1.66 birds/year
20-year project life (without temporary met towers)	17 adults/immatures and 10 chicks/eggs

Requested ITP and ITL Authorization

Baseline annual level of take	4 adults/immatures and 3 chicks/eggs 7 birds/year
5-year limit of take	8 adults/immatures and 5 chicks/eggs
20-year limit	18 adults/immatures and 11 chicks/eggs

Higher Rate of Take

One-year period	Total direct take of >4 - 8 adults/immatures and > 4 - 5 chicks/eggs
5-year period	Total direct take of >8 - 12 adults/immatures and >5 - 8 chicks/eggs
20-year limit	Total direct take of >18 - 27 adults/immatures and >8 - 17 chicks/eggs

Lower Rate of Take

5-year period	Total direct take of ≤ 2.25 adults/immatures and ≤ 1.4 chicks/eggs
20-year limit	9 adults/immatures and 6 chicks/eggs

As indicated in Section 3.8.1.1, the current population of Hawaiian petrel is estimated to be approximately 20,000 birds, with 4,000 to 5,000 breeding pairs (Mitchell et al. 2005). Thus, the expected rate of take (essentially one adult per year) represents approximately 0.005% of the estimated Hawaiian petrel population, and the higher rate (27 petrels/20 years = 1.35 adults per year) represents approximately 0.01%. Given these very low percentages, it is considered extremely unlikely that take of Hawaiian petrel caused by the proposed project would result in significant adverse effects to Hawaiian petrel at the population level. The seabird colony at Haleakalā, Maui, is composed of as many as 1,000 nesting pairs or approximately one-fifth to one-quarter of the total breeding population (Mitchell et al. 2005, Tetra Tech EC, Inc., June 2008). The number of birds breeding in West Maui is not known. The expected and Higher rates of take could represent from 0.025% to 0.3% of the minimum (1,000 pairs) Maui population if all birds taken were breeding birds rather than non-breeding visitors to their colonies. These percentages are also quite low, although if a Higher rate of annual take was realized consistently, it might eventually result in a measurable reduction in the Maui population in absence of the proposed mitigation measures (discussed in Section 6.3). At current population levels, higher rates of take are expected to occur only in the unlikely event that less than 97.5% of the petrels passing over the site fail to detect and avoid the turbines and met towers (Cooper and Day 2009). The observed take of just one Hawaiian petrel at KWP after three and a half years of operation suggests that higher rates of take are unlikely to occur. Because it is anticipated that take will occur on average at the rate of approximately one adult per year, loss of Hawaiian petrels as a result of the proposed project is considered unlikely to result in a biologically significant reduction in the Maui population of this species.

Predation by introduced mammals and downing due to urban lighting are considered the primary threats to recovery of Hawaiian petrel. The proposed mitigation measures described in the following chapter are expected to more than offset the anticipated take and contribute to recovery of the species by providing a net conservation benefit, as required by State law. For this reason, no significant adverse impacts to the species' overall populations, and no significant cumulative impacts to the species, are anticipated. With the low expected rate of take, the proposed mitigation measures are expected to produce a measurable net benefit in the form of a marginal increase in the population of Hawaiian petrels.

5.2.3 Newell's Shearwater

5.2.3.1 Risk of Newell's Shearwater Collision with WTGs

In the 2009 Summer and Fall study conducted by Cooper and Day (2009) (see section 5.2.2.1 and Appendix 3 and 13 for details), fatality estimates for Newell's shearwater ranged from 0.008 to 0.11 birds/turbine/year or 0.011 to 1.51 birds/year for all 14 turbines combined based on 90%, 95% and 99% avoidance rates. To date, no Newell's shearwater fatalities have been recorded at KWP. However, for the purpose of estimating fatality rates at KWP II, the 97.5% avoidance level was used to remain consistent with the rate used for Hawaiian petrel (see Section 5.2.2.1 for details). Using the 97.5% avoidance rate, the estimated average fatality rate of Newell's shearwater at KWP II calculates to 0.027 birds/turbine/year or 0.38 birds/year for all 14 turbines combined.

Fatality estimates were also modeled for one permanent un-guyed 213-foot (65-m) lattice met tower. This modeling predicts an average mortality ranging from 0.004 to 0.040 shearwaters/met tower/year based on 90%, 95% and 99% avoidance rates. For the purposes of estimating fatality rates at KWP II, the 95% avoidance level was chosen to remain consistent with the rate used for the Hawaiian petrel, resulting in an estimated fatality rate for Newell's shearwater at 0.020 birds/tower/year

5.2.3.2 Other Direct Take of Newell's Shearwaters

In addition to collisions with turbines and met towers, some limited potential exists for Newell's shearwaters to collide with cranes during the construction phase of the project. As discussed for Hawaiian petrel, potential for Newell's shearwaters to collide with construction cranes is considered negligible, given the brevity of the construction period and the low rate of occurrence

of the species on-site. Also, the permanently stationed maintenance crane is not expected to constitute a collision threat to Newell's shearwater because it is expected to be used only during the day and stored in a horizontal position at night. No Newell's shearwaters collided with cranes used to construct the KWP facility.

Potential also exists for Newell's shearwaters to collide with the 1225 foot (374 m) section of the collection line that crosses the gulch at the upper portion of the project area (see Section 1.4 for details). This line will be mounted on poles approximately 60 - 90 feet (18 - 25 m) above ground level and will be a maximum of 340 ft (104 m) above the deepest part of the gulch. Precautions to minimize collisions include installing marker balls on the collection line to enhance visibility and placing the collection line in close proximity to an existing transmission line of the same height that also crosses the gulch and is similarly marked (see Section 4.3.1). Observation of Newell's shearwaters on Kauai by Day et al. (in review) suggests that collision avoidance rates of powerlines by Newell's shearwaters may be approximately 97% (392 observed birds with 29 birds exhibiting collision avoidance responses and one resultant collision (=1/30)). Thus, the collision rate of Newell's shearwaters with the overhead collection line is expected to be low. Thus the collision rate of Newell's shearwaters with overhead collection lines is considered very small and assigned a value of 0.1 birds/year (one bird every ten years) given the low occurrence rate of species on the site, their avoidance capabilities and the minimization measures that will be emplaced.

As with Hawaiian petrels, some potential also exists for construction or maintenance vehicles to strike downed shearwaters (birds already injured by collision with turbines, towers or collection lines) while traveling project roads. Project personnel will be trained to watch for downed shearwaters and other wildlife and speed limits (10 mph) will be emplaced and enforced to minimize potential for vehicular strikes to result in death of birds that otherwise might have been able to be rehabilitated. Despite this, it is assumed that day-to-day maintenance of the wind facility may very occasionally result in the fatality of a shearwater. This source of mortality does not result in an increase in the amount of direct take expected from the proposed project because the collisions by these birds are accounted for in the mortality modeling.

Therefore, for this HCP, it is projected that take of Newell's shearwater as a result of collision with project components and vehicle strikes will occur at the average rate of 0.50 shearwaters/year (0.38 (turbine) + 0.02 (met tower) + 0.1 (collection line) =0.50).

5.2.3.3 Indirect Take for Newell's Shearwater

As with Hawaiian petrels, **adult and immature** shearwaters are most likely to collide with turbines or associated structures while commuting between nesting and feeding grounds during **the pre-laying period (April to May), incubation and chick-feeding periods (June to October) and fledging period (October to November)**. Newell's shearwaters are not expected to be flying across the project area at other times of year. Based on the above, an indirect take assessment would be applied to any adult shearwaters found directly taken from June through October. Indirect take would not be assessed to adult shearwaters found at other times of year or applied to immature shearwaters. As with Hawaiian petrels, both shearwater parents care for their eggs and chicks. As little information is available for Newell's shearwaters on nestling growth and development or adult visitation rates, it is assumed that both parents are necessary throughout the breeding season for successfully fledging a chick.

Not all Newell's shearwaters visiting a nesting colony breed. It was estimated by Ainley et al. (2001) that only 46% of all active burrows produced an egg. Moreover, most non-breeding birds and failed breeders leave the colony for the season by August (Ainley 2001). Therefore, it appears there would be a 46% chance that an adult petrel taken from May through August was actually breeding, but nearly a 100% chance that birds taken in September or October would be tending to young. Based on the above life history parameters and as identified in Table 5.4 below, indirect take would be assessed at the rate of 0.46 eggs or chicks per adult taken between May and August, 1.00 chick per adult taken in September through October (life history data presented can also be found in Appendix 7).

Table 5.4. Calculation of Indirect Take for Newell's Shearwater

Newell's shearwater	Season	Average no. of chicks per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Adult	Apr - May	--	0	--	0.00
Adult	Jun-Aug	1	0.46	1.0	0.46 eggs/chicks
Adult	Sept-Oct	1	1	1.0	1 chick
Adult	Nov - May	--	0.00	--	0.00
Immature	All year	--	0.00	--	0.00

5.2.3.4 Estimating Total Take for Newell's Shearwater

The estimated average mortality rate of Newell's shearwater allowing for potential collisions with WTGs and permanent met towers and adjusted for potential for overhead collection line strikes is 0.50 shearwaters/year. Based on estimated rates of direct and indirect take, annual take of this species resulting from project operations is expected to average 1.0 bird/year (0.50 adults/year + (1 chicks/year x 0.50) = 1 bird/year).

Because of assumptions concerning unobserved direct take, any one Newell's shearwater found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one, with total direct take then likely to be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates).

Moreover, as take may be distributed unevenly over the years (see Section 5.2), based on the above, the Applicant suggests the ITP and ITL should allow for a total direct take of up to four Newell's shearwaters and the indirect take of two chicks for any given year for the duration of the project (see below for calculation of indirect take). A 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and 15 adults every 20 years). See section 5.2 for a detailed explanation.

Birds "taken" through assessment of "unobserved direct take" will be assumed to have been of the same age and breeding status as the individual that was found. As the amount of indirect take assessed is dependent upon when the direct take occurs during the breeding season, for the purposes of calculating the expected indirect take, it was assumed that direct take has an equal probability of occurring anytime between April and November. This period includes the pre-laying period (April to May), the breeding season (June to October) and fledging period (November). It is expected that only adults or immatures will be take from April to October and only fledglings will be taken in November. This distribution of fatality over the breeding season (eight months long) was used to determine the expected amount of indirect take. For example, for a total direct take of ten shearwaters, a total direct take of 2.5 individuals would be expected to occur from April to May (=10 x 2 months/8 months) over the life of the project (Table 5.3). Table 5.5 shows the expected distribution of direct take over the breeding season and the indirect take that would be subsequently assessed (derived from Table 5.2) for the **Baseline** requested take levels.

Table 5.5 Allocation of Indirect Take for Newell's Shearwater for Baseline Requested Take Levels

Newell's shearwater	Adult (April - May)	Adult (June-Aug)	Adult (Sept-Oct)	Fledgling (Nov)	Total
Direct take	2.5	3.75	2.5	1.25	10
Indirect	0	1.1	2.5	0	4 (=3.6)

Actual expected rates of take and rates of take of Newell's shearwaters requested to be authorized by the ITL and ITP through the expected 20-year life of the project are summarized below. Also provided below are rates of take proposed to qualify as "Lower," and "Higher" for purposes of identifying when it would be appropriate or necessary to consider adaptive management practices.

Expected Rate of Take

Annual average 0.50 adults/immatures and 0.50 chicks/eggs
1.0 bird/year

20-year project life (without temporary met towers) 10 adults/immatures and 4 chicks/eggs

Requested ITP and ITL Authorization

Baseline annual level of take 4 adults/immatures and 2 chicks/eggs
6 birds/year
5-year limit of take 6 adults/immatures and 3 chicks/eggs
20-year limit 10 adults/immatures and 4 chicks/eggs

Higher Rate of Take

One-year period Total direct take of >4 – 6 adults/immatures and >2 – 3 chicks/eggs
5-year period Total direct take of >6 – 9 adults/immatures and >3 – 4 chicks/eggs
20-year period Total direct take of >10 – 15 adults/immatures and >5 – 6 chicks/eggs

Lower Rate of Take

5-year period Total direct take of ≤ 1.3 adults/immatures and ≤ 0.5 chicks/eggs
20-year limit 5 adults/immatures and 2 chicks/eggs

As indicated in Section 3.8.2.1, the most recent population estimate of Newell's shearwater was approximately 84,000 birds, with a possible range of 57,000 to 115,000 birds (Ainley et al. 1997). However, radar studies and population modeling have indicated that the population of Newell's shearwater is likely on a decline especially on Kaua'i (Ainley et al. 2001, Day et al. 2003). Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997, Mitchell et al. 2005, Hays and Conant 2007).

The expected rate of take (essentially one adult every two years) represents approximately 0.0005 of the estimated Newell's shearwater population, and the higher rate (15 shearwaters / 20 years = 0.75 adults per year) represents from approximately 0.001%. Given these very low percentages, it is considered extremely unlikely that take caused by the proposed project would

result in significant adverse effects to Newell's shearwater at the population level. Rates of take at the Higher level may present a greater risk for the subset of the population that breeds on Maui, which is poorly known but presumed small. Again, at current population levels, Higher rates of take are expected to occur only in the unlikely event that less than 97.5% of the shearwaters passing over the site fail to detect and avoid the turbines and met towers (Cooper and Day 2009). Lack of observed Newell's shearwater mortality at KWP after three and a half years of operation suggests that Higher rates of take are unlikely to occur. As such, the proposed mitigation measures (Section 6.3) are expected to more than offset the anticipated take and contribute to the species' recovery by providing a net conservation benefit, as required by State law. For this reason, no significant adverse impacts to the species' overall population, and no significant cumulative impacts to the species, are anticipated.

5.2.4 Nēnē

Past surveys and extensive monitoring prior to and during the nearly four-year operation of KWP have established that a population of nēnē occurs in the general project area of KWP and KWP II (Day and Cooper 1999; Cooper and Day 2004a; Kaheawa Wind Power 2008b, 2008c, 2007a, 2007b). DOFAW operation of the captive release and reintroduction pen at Hana'ula near the upper end of the KWP site has for all intents established the population of nēnē in the Kaheawa area. As of 2006, 104 nēnē had been released from this pen since releases began in 1994. Observations at KWP confirm that nēnē are resident in and around the KWP and KWP II area. At KWP, birds are on the ground browsing, socializing, nesting, and using habitat and terrain features for cover. Nēnē are not expected to nest at the KWP II Downroad area owing to a lack of suitable nesting habitat (see section 3.8.3.3 and 5.2.4.2). Nēnē commonly fly at altitudes that are within the RSZ of the KWP and proposed KWP II WTGs, with most birds observed during daylight and crepuscular periods.

5.2.4.1 Nēnē Collision Risk and Avoidance Behavior

Nēnē at KWP are commonly observed displaying avoidance behavior and maneuverability in the vicinity of project structures and moving rotors (Spencer pers. comm., Kaheawa Wind Power 2008b, 2008c). While this indicates that the geese generally see and avoid the WTGs, three nēnē mortalities from wind turbine collisions have been **observed** since June 2006, when the 20 KWP WTGs became operational. The first incident in October, 2007 occurred during an ordinary period of strong trade winds. The second and third incidents were closely correlated with abrupt changes in local weather that included increases in local wind speeds and cloud cover associated with large scale weather events that may have significantly reduced visibility of the WTGs. **This suggests that nēnē may be more vulnerable to collisions with turbines, met towers, and other structures during periods of strong winds and low visibility.**

After adjusting the observed direct take at KWP for the effects of searcher efficiency and carcass removal by scavengers, the estimated total direct take at this facility after 3.5 years of operation has been **1.21 birds/year or 0.06 birds/turbine/year (Kaheawa Wind Power 2009, Appendix 16).** As nēnē are encountered less frequently the KWP II area than at KWP (35% of all nēnē sightings have been made in the Downroad area vs. 65% of sightings at KWP, see section 3.8.3.3), the risk of nēnē colliding with the turbines is assumed to be 0.54 ($=35/65$) times the risk at KWP per turbine. This results in an expected mortality of 0.032 birds/turbine/year or 0.45 birds/year for all 14 turbines combined.

In addition to collisions with WTGs, some potential exists for nēnē to collide with the temporary and permanent met towers and construction equipment such as cranes during the construction phase of the project. To date, no nēnē have been found to have collided with met towers at KWP. Potential for the birds to collide with met towers is essentially accounted for in the estimated rate of take extrapolated from the KWP data since the rate of take at KWP was developed by dividing the sum of all project-related take (take caused by met towers was zero) and dividing that by the number of turbines.

No nēnē collided with any cranes during the construction phase of that project. As discussed for the two seabird species, the one permanently stationed crane is not expected to pose a collision

threat to the nēnē because it is expected to be used during the daytime and stored in a horizontal position at ground level when not in use. Nēnē should also be able to avoid collisions with the overhead collection lines while flying and the new collection lines will be strung with marker balls to increase their visibility. No nēnē collisions with the overhead lines already on site have been documented thus far. Because nēnē are comparatively large birds, the potential for construction or maintenance vehicles to strike downed nēnē is considered to be negligible because of the proposed staff training measures and project road speed limit of 10 mph.

Concerns that immediate revegetation measures conducted on-site may present foraging opportunities for nēnē, thereby attracting nēnē to the vicinity of the turbines, have arisen during discussions with DLNR and USFWS. However, based on observations by KWP biologists, nēnē are attracted to grass used in immediate revegetation mainly during the early emergent phase of growth and hence revegetation measures will be a source of attraction for only a short period of time. Nēnē in flight have also been documented to exhibit avoidance behavior around turbines (Kaheawa Wind Power, 2008b, c), hence the risk to nēnē due to attraction resulting from revegetation with grasses is considered minimal.

Based on the above, it is estimated the total proposed KWP II project would result in an average direct take of 0.55 nēnē/year.

5.2.4.2 Ground Displacement of Nēnē

In general, animal species can be indirectly and adversely affected by the clearing of their habitat in multiple ways. The most obvious is through displacement. For animal species with small home ranges, or for projects that result in disturbance to large areas, clearing of habitat can completely remove the home range of an individual animal and thus reduce the carrying capacity of the area affected. Such animals are then typically displaced to either compete for space with individuals in remaining habitat or forced to occupy sub-optimal or non-suitable habitat. In either case, the loss of habitat usually results in an overall decrease in the effective population size of the species because some individuals may no longer be able to establish territory, attract a mate, and reproduce.

Clearing of habitat can also adversely affect species through reduction of habitat patch sizes and through habitat fragmentation. Some animals will not utilize patches of habitat that are below some minimum threshold size even though that minimum size is larger than their own home range. Thus, while clearing for a development project might reduce in size but not completely eliminate a certain patch of habitat, the clearing could cause the remaining habitat to be rendered unsuitable for continued use by a particular species. Similarly, clearing could cause one larger patch of habitat to be divided or "fragmented" into two or more smaller patches, with these smaller patches then being incapable of supporting a species that requires large blocks of habitat.

Even in cases where clearing of vegetation may divide one large block of habitat into two smaller blocks that each remain large enough to continue to support a given species, the development that follows vegetation clearing can sometimes create a barrier to movement by that species between the habitat patches. In some cases, the population of the species occurring on one or both sides of the barrier could then be made at risk of extinction because the remaining population may be less able to withstand additional perturbations.

In addition to possibly causing deleterious reduction in habitat patch sizes, fragmentation of habitat can result in harmful changes to the quality of surviving habitat. Clearing of vegetation creates edges that can alter microclimatic conditions within habitat by exposing the habitat to wind and sun. Changes in microclimatic conditions have potential to alter habitat to a point where it becomes unsuitable for use by a particular species. This type of effect is typically realized in forested habitats (where, for example, a previously shaded, humid understory could through clearing be dried through new exposure to sun and wind) as opposed to open habitats.

With regard to nēnē and the proposed KWP II project, the KWP II project area supports vegetation that provides some, (though limited) browsing and sheltering opportunities. Clearing for turbine pads, roads, and other project-related facilities would cause the loss of approximately 43 acres

(17.4 ha) of mostly grassy vegetation out of the 143-acre (58-ha) KWP II project area, with the clearing generally occurring in linear swaths or in circular areas around turbine locations. This clearing is not expected to result in adverse modification to the microclimate of surviving habitat in the KWP II project area since those types of habitat are already fully exposed to sun and wind.

Clearing for the project, while it would result in the presence of (mostly linear and narrow) barren areas within the otherwise rocky and vegetated landscape of KWP II, is also not expected to cause adverse effects to nēnē as a result of habitat fragmentation. Through the first 3.5 years of KWP operations, KWP and DOFAW biologists have observed nēnē using portions of the combined KWP and KWP II area and, at KWP, successfully nesting within and adjacent to the project area. Nēnē are frequently seen at KWP utilizing the roads and turbine pads for loafing, walking and vigilance (behavioral categories from Woog and Black 2001). These observations suggest that nēnē readily adapt to the presence of WTGs and should continue to utilize available habitat in the vicinity of the KWP II wind facilities. These observations further indicate that nēnē incorporate clearings of the type constructed for a wind power project into their home ranges. As such, these clearings do not create barriers to movement between vegetated areas and do not cause habitat occurring on one side of a clearing to be reduced in size to a point where it could no longer be considered capable of supporting nēnē.

The remaining question is whether the magnitude of loss of the existing grassy habitat that provides limited feeding and sheltering opportunities would be sufficient to cause the displacement of geese from the KWP II area.

Differences in vegetation between the KWP and KWP II project areas and observation of patterns of habitat usage by nēnē at KWP and KWP II indicate that the quality of nēnē habitat is not consistent between the two project areas. Habitat such as that in the KWP project area, which has proven capable of supporting nesting and the nutritional requirements of nēnē, does not appear to be present in the KWP II area. Unlike the KWP project area, vegetation in the KWP II project area is dominated by non-native windblown, fire-adapted grasses with some scattered shrubs and trees in the gullies. The KWPII area is also drier than the KWP area, with lower elevations of the KWP II area receiving as much as 20" less rainfall than the upper parts of KWP (see Figure 3.3).

Hobdy (2009) identified a total of 15 native species in the KWPII project area. Some of the native plant species present at KWPII are identified as species that nēnē can utilize either as a food source or shrubs to shelter or nest under (USFWS 2004). The food species are 'ilima (*Sida fallax*), ulei (*Osteomeles anthyllidifolia*) and pili (*Heteropogon contortus*), and nēnē are known to shelter or nest under 'a'ali'i (*Dodonaea viscosa*). 'Ilima, is widely scattered throughout the KWP II area, but of very short stature; pili and ulei, are scattered sparsely throughout the area or occur only in a few small patches (Hobdy 2009, 2010). 'Ilima is one of the most common native dryland plants in all of Hawai'i (Hobdy 2009, 2010). In addition, another 9 native species were found in the area that will be trenched for the underground cables (Hobdy 2010). The trenched area is a 1500ft long corridor and nēnē food plants that may be impacted include naupaka kuahiwi (*Scaevola gaudichaudii*), pukiawe (*Leptecophylla tameiameia*), 'ilima. All three species were either scattered sparsely throughout the area or occur only in a few small patches or consisted of a few isolated individuals (uncommon to rare in the area).

Nēnē are most often seen at the upper project area of KWPII near the Lahaina Pali trail or slightly above the project area at the 2.25 Mile marker (see Figure 3.3). During the winter months, if rainfall is adequate, the bunch grass-dominated pastures at KWPII produce greater numbers of seedheads, creating a short-term source of browse for some birds. However, this is an unpredictable food source and likely only a temporary and supplemental resource for nēnē. Moreover, unmanaged grasslands are typically nutritionally poor in general, especially so when they occur in dry areas (Woog and Black 2001).

'A'ali'i are a common native shrub species scattered sparsely throughout the KWP II area. Over the years repeated wildfire events have severely affected this region and appear to have suppressed the growth of native shrubs, which do not seem to occur in large enough patches or high enough stature to provide adequate nesting or shelter for the nēnē in the area. In addition,

given the poor nutritional quality of the surrounding habitat, it is unlikely to be used with any regularity. So far, evidence suggests that the higher elevation portions of the upper KWP II project area may only provide a temporary foraging habitat for nēnē particularly after the rains, and no nēnē thus far have been detected nesting in the proposed project area. The absence of suitable nesting/sheltering habitat and the low nutritional quality of most plant species common in the area have probably discouraged nēnē from becoming more established in the KWP II project area. Pukiawe and ohia (*Metrosideros polymorpha*) were present in the area that will be trenched for the underground cables but were also either scattered sparsely throughout the area or occurred only in a few small patches or consisted of a few isolated individuals (uncommon to rare in the area).

The proposed conversion of approximately 43 ac of open field habitat for KWP II project-related purposes may reduce to some degree the amount of low-quality foraging habitat available for nēnē in the project area. In addition, a very small area will be trenched for the underground cables, which may temporarily eliminate a very limited number of native food plants or plants that have potential shelter or nesting functions.

In conclusion, given the very limited function of the areas to be altered in the main KWPII project area, and the abundance of better quality habitat elsewhere, the construction of KWPII is not expected to measurably displace, or adversely reduce foraging or nesting opportunities for any individuals of the resident population.

5.2.4.3 Indirect Take of Nēnē

It is assumed that adult nēnē are most likely to collide with turbines and associated structures during non-breeding periods (May through July) or at the end of their breeding period when the adults and young may travel as family groups. Nēnē are highly territorial during the breeding season (Banko et al. 1999) and males are likely to be defending nesting territories while the females are incubating. Upon hatching, both parents would be attending to heavily dependent young; adult nēnē also molt while in the latter part of their breeding period and are therefore flightless for 4 to 6 weeks (USFWS 2004). These adults attain their flight feathers at about the same time as their goslings (USFWS 2004). Consequently, such birds are more likely to be in flight within KWP II only when goslings have already fledged.

Indirect take to account for loss of dependent young will be assessed for adult nēnē only when mortality occurs during the breeding season (August to April). Adults found during the months of October through March will be assumed to have had a 60% chance of having been actively breeding because 60% of the population has been recorded to breed in any given year (Banko et al. 1999). Adult nēnē mortality that occurs outside the peak breeding season (April, August, and September) will be assumed to have had a 25% chance of breeding. Male and female nēnē care for their young fairly equally, so indirect take would be assessed equally to the direct take of any male or female adult nēnē found during the breeding season. Because breeding nēnē are not expected to collide with WTGs prior to the fledging of their young, it is assumed that the number of young possibly affected by loss of an adult would be based on the average number of fledglings produced per pair (studies indicate that average number of fledglings produced annually per pair of nēnē is 0.3 (Hu 1998)).

Based on these assumptions, as indicated in Table 5.6 below, the amount of indirect take that would be assessed for each direct take of an adult nēnē during the months of October through March is 0.09. Amount of indirect take assessed for each direct take of an adult bird during the remainder of the breeding season would be 0.04 (life history data presented can be found in Appendix 7).

Table 5.6 Calculation of Indirect Take of Nēnē

Nēnē	Season	No. fledglings per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect (A*B*C)
Adult, any gender	Oct - Mar	0.3	0.60	0.5	0.09
Adult, any gender	April, Aug, and Sep	0.3	0.25	0.5	0.04
Adult, any gender	May - July	--	0.00	--	0.00
Immature	All year	--	0.00	--	0.00

5.2.4.4. Estimating Total Take for Nēnē

Based on estimated rates of direct and indirect take, annual take of this species resulting from project operations is expected to be no more than **0.49 birds** or essentially one bird per year. This is based on the expected rate of **0.45 adults/year** with assessment for indirect take ($0.45 + (0.09 \text{ fledglings/year} \times 0.45) = 0.49$).

The DLNR and ESRC have recommended that annual take limits allow for at least one **observed** take a year. Because of assumptions concerning unobserved direct take, any one nēnē found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one that likely would be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates). Moreover, as take may be distributed unevenly over the years (see Section 5.2), based on the above, the Applicant suggests the ITP and ITL should allow for a total direct take of at least four adult nēnē and the indirect take of one fledgling for any given year for the duration of the project (see below for calculation of indirect take).

While the birds attributed to unobserved take would be assumed and, therefore, of unknown age or gender, for the purposes of this HCP it will be assumed that all birds taken through "unobserved direct take" will be of adults. Because nēnē could be flying through the project area at any time of year, the likelihood of an "unobserved take" of nēnē being in breeding condition is 37.5% based on a breeding period of 4.5 months (a one month incubation period followed by parental care for 3.5 months; $4.5 / 12 = 0.375$).

Consequently, following the above table, indirect take will be assessed to nēnē lost through "unobserved direct take" at the rate of 0.06 fledglings/nēnē ($0.3 \times 0.375 \times 0.50 = 0.0563$). In addition to the annual rate of take, a 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and 15 adults every 20 years). See section 5.2 for a detailed explanation. Expected rates of take and rates of take requested to be authorized by the ITP and ITL through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as "Lower" and "Higher."

Expected Rate of Take

Annual average	0.45 adults/immatures and 0.04 fledglings	0.49 birds/year
20-year project life	9 adults/immatures and 1 fledgling	

Requested ITP and ITL Authorization

Baseline annual level of take	4 adults/immatures and 1 fledgling	5 birds/year
5-year limit of take	8 adults/immatures and 1 fledgling	
20-year limit	18 adults/immatures and 2- 3 fledglings	

Higher Rate of Take

One-year period	Total direct take of >4 - 6 adults/immatures and >1 fledgling
5-year period	Total direct take of >8 - 12 adults/immatures and >2 -3 fledglings
20-year period	Total direct take of >18 - 27 adults/immatures and >2 - 3 fledglings

Lower Rate of Take

5-year period	Total direct take of ≤ 2.25 adults/immatures and ≤ 1 fledglings
20-year limit	9 adults/immatures and 2 fledglings

The population of nēnē statewide currently number at an estimated 1,300 individuals with 315 birds occurring on Maui (DOFAW unpub. data 2003). The Baseline rates of take estimated for nēnē are not expected to cause a decline in the status of the species although the Higher levels, should they persist indefinitely, could result in a decline of the local population that has been established in the vicinity of the Hana'ula release pen. However, when considered in light of the proposed mitigation (see Section 6.4), even the higher levels of take can be compensated by the proposed mitigation when the adaptive management provisions are implemented. Proposed mitigation measures will also contribute to the species' recovery by providing a net conservation benefit, as required by State law. For this reason, no significant adverse impacts to the species' overall populations, and no significant cumulative impacts to the species, are anticipated.

5.2.5 Hawaiian Hoary Bat

Low rates of activity by Hawaiian hoary bat have been measured at KWP (see section 3.8.4.3). The lack of visual observations and low recorded activity levels at KWP suggest that only a small number of bats utilize the general area. Bats are not expected to breed or roost at KWP II due to the lack of trees. Due to the similarity in terrain between KWP and KWP II, the estimated mortality at KWP II is expected to be similar or lower than the mortality rates occurring at the existing KWP site. Hawaiian hoary bats breed from 0 to 4200 feet (1280 m) in elevation (Menard 2001), so it is possible that volant juveniles occur in the project area in the latter portion of the breeding season.

5.2.5.1 Collision Risk and Other Potential Causes of Take at KWP II

The potential for take of the Hawaiian hoary bat is believed to be very low based on the surveys that have been conducted at the KWP and KWP II project areas, the limited available information regarding the species occurrence on West Maui, and the apparent relatively low susceptibility of resident (versus migrating) bats to collisions with wind turbines in general. However, the occurrence of at least a few individuals in the project area has been documented, and one observed fatality has been recorded at the KWP facility over 3.5 years of project operation.

The one fatality recorded at KWP equates to a total direct take **0.57 bats/year for KWP or 0.028 bats/turbine/year (Kaheawa Wind Power 2009, Appendix 16)**. Extrapolating this rate to KWP II results in an average direct take of 0.39 bats/year for all 14 turbines at KWP II.

Potential for bats to collide with met towers or cranes is considered to be negligible because they would be immobile and should be readily detectable by the bats through echolocation. Of 64 wind turbines studied at Mountaineer Wind Energy Center in the Appalachian plateau in West Virginia, bat fatalities were recorded at operating turbines, but not at a turbine that remained non-operational during the study period. This supports the expectation that presence of the stationary

structures such as an un-guyed lattice met tower and crane should not result in bat fatalities (Kerns et al. 2005). No bats have been found to have collided with the guyed met towers at KWP after 3.5 years of operation nor with any cranes during the construction phase of that project. No downed bats have been found during the weekly searches of the one guyed temporary met tower at the Kahuku Wind Power site. Weekly searches began in October 2008 and are ongoing. This search plot has been regularly mowed since April 2009. Potential for the bats to collide with met towers is also essentially accounted for in the estimated rate of take extrapolated from the KWP data since the rate of take at KWP was developed by dividing the sum of all project-related take (take caused by met towers was zero) and dividing that by the number of turbines.

5.2.5.2 Indirect Take

Hoary bats are thought to move to higher elevations during the months of January through March (Menard 2001), and so may be less prevalent in the project area during those months. However given the lack of empirical data and for the purposes of the HCP, it is assumed that levels of bat activity on-site remain constant throughout the year. Consequently, adult bats are considered to have equal potential to collide with turbines throughout the year and regardless of breeding status.

Hawaiian hoary bats breed between April and August (Menard 2001). Females are solely responsible for the care and feeding of young, and twin pups are typically born each year, although single pups sometimes occur. To date, no breeding records for Hawaiian hoary bat exist for Maui, however, any female bats directly taken from April through August will be examined and, if determined to be pregnant or lactating, indirect take will be assessed. No indirect take will be assessed for female bats found at other times of year, or for male or immature bats found at any time of year. The rate at which indirect take will be assessed for pregnant or lactating female bats found during the months of April through August is 1.8 juveniles per adult female as indicated in Table 5.7 below (life history data presented can be found in Appendix 5).

Table 5.7 Calculating Indirect Take for the Hawaiian Hoary Bat

Hawaiian hoary bat	Season	Average no. of juveniles per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Female	Apr-Aug Pregnant or lactating	1.8	1.0	1.00	1.80
Female	Sep-Mar	--	0.0	--	0.00
Male	All year	--	0.0	0.00	0.00
Immature	All year	--	0.0	--	0.00

5.2.5.3 Estimating Total Take for the Hawaiian Hoary Bat

As indicated, the average rate of direct take of Hawaiian hoary bats as a result of project operations is expected to be 0.39 bats per year. Indirect take associated with this level of direct take would result in a maximum of 0.70 juveniles per year ($=0.39 \times 1.8$) resulting in a total adjusted take of 1.09 bats/year or essentially one bat per year (see Table 5.7, life history data presented can be found in Appendix 7).

As with the other species addressed in this HCP, the DLNR and ESRC have recommended that annual take limits allow for at least one **observed** take a year. Again, because of assumptions concerning unobserved direct take, any one Hawaiian hoary bat found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one likely to be rounded up to four bats (based on expected results from take monitoring and expected subsequent adjustments for searcher efficiency and scavenging rates). Existing literature on adjusting total direct take for bats suggest that a ratio of one observed take to three

unobserved takes is not unreasonable and may be conservative (e.g. Arnett 2005, Jain et al. 2007, Fiedler et al. 2007).

While the other bats taken under this scenario would be assumed and, therefore, of unknown age or gender, for the purposes of this HCP it will be assumed that all Hawaiian hoary bats taken through “unobserved direct take” will be adults and will have a 50% chance of having been female (based on the sex ratio of males to females during the breeding season). In addition, because bats could be flying through the project area at any time of year, the likelihood of an “unobserved direct take” of a bat being in breeding condition is further assumed to be 33%. This is based on Hawaiian hoary bats producing one brood a year, and having a four-month breeding period (three months of gestation and one month of parental care, NatureServe 2008). Consequently, following the above table, indirect take will be assessed to bats lost through “unobserved direct take” at the rate of 0.30 juveniles/bat ($=0.5 \times 0.33 \times 1.8$).

Indirect take assessed to a total direct take of 4 bats could range up to 3 juveniles ($= (1 \times 1.80) + (3 \times 0.30)$). Consequently, the Applicant suggests the ITP and ITL should allow for a total direct take of up to 4 adult or volant juvenile Hawaiian hoary bats and the indirect take of up to 3 dependent juvenile bats for any given year for the duration of the project. A 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and 15 adults every 20 years). See section 5.2 for a detailed explanation. Expected rates of take and rates of take requested to be authorized by the ITP and ITL through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as “Lower” and “Higher”.

Expected Rate of Take

Average	0.39 adults and 0.70 juveniles	1.09 bats/year
20-year project life	8 adults and 6 juveniles (assuming half of all direct take is female)	

Requested ITL Authorization

Baseline annual level of take	4 adults/immatures and 3 juveniles	7 bats/year
Five-year limit of take	10 adults/immatures and 8 juveniles	
20-year limit	12 adults/immatures and 9 juveniles	

Higher Rate of Take

One-year period	Total direct take of 5 - 8 adults/immatures and 3 - 6 juveniles
5-year period	Total direct take of 11 - 12 adults/immatures and 8 - 9 juveniles
20-year period	Total direct take of 13 - 18 adults/immatures and 9 - 14 juveniles

Lower Rate of Take

5-year period	Total direct take of ≤ 1.5 adults/immatures and ≤ 1.1 juveniles
20-year limit	6 adults/immatures and 5 juveniles

The most recent population estimates for Hawaiian hoary bat have ranged from several hundred to several thousand (Tomich 1969, Menard 2001). The Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998) states “since no accurate population estimates exist for this subspecies and because historical information regarding its past distribution is scant, the decline of the bat has been largely inferred.” Although overall numbers of Hawaiian hoary bats are believed to be low, they are thought to occur in the greatest numbers on the island of Hawai‘i and Kaua‘i (Menard 2001).

It is difficult to gauge the effect that take of Hawaiian hoary bat resulting from the proposed project may have on the population of this species because its population is not known. The identified baseline level of take is low and so it seems unlikely that take at this rate would result in

a significant impact on the overall population of the Hawaiian hoary bat. Higher levels of take may begin to impact the Maui population, if the population is very small, but such take would not likely impact the status of the species on other islands where populations are assumed to be more robust. The Applicant's proposed mitigation for the anticipated take (see Section 6.5) will contribute to restoration of native bat habitat should result in an overall net conservation benefit for the species.

5.3 CUMULATIVE IMPACTS

The Auwahi Wind Farm on East Maui has recently begun the process of preparing an Environmental Impact Statement under Hawaii Chapter 343 (Auwahi Wind Farm EISPN 2010), and consultation with DOFAW and USFWS regarding a Habitat Conservation Plan to address the potential for incidental take of Hawaiian hoary bats, Newell's shearwaters, and Hawaiian petrels. If the project is ultimately approved, and take is anticipated, there is a potential for cumulative impacts to these species. However, the anticipated take levels and proposed mitigation have not yet been determined and so the magnitude of potential impacts remains unknown Pursuant to HRS §195D-4(g), in order to qualify for an Incidental Take License a project must prepare and implement a HCP that, among other things, increases the likelihood that the species will survive and recover and provides net environmental benefits. Accordingly, the proposed mitigation for KWP II is expected to more than offset the anticipated take and provide a net benefit to the species, and net adverse impacts are not anticipated. If approved, the mitigation for the proposed Auwahi Wind Farm would need to meet the same standard, and thus cumulative adverse impacts would not be anticipated, nor permitted.

At a broader scale, KWP II represents one of many projects of various types that can be expected to occur on the Island of Maui. Some of the causes of decline of the Covered Species (such as mammal predation, bright light disorientation, and loss of nesting or roosting habitats) may be on the increase due to continued real estate development on Maui, and will likely continue increasing in the future. Even when conducted in compliance with all applicable local, state, and federal environmental regulations, there is the potential for cumulative impacts to occur from these projects because many do not trigger review under endangered species provisions and thus are not required to meet the "net environmental benefit" standard. By implementing this HCP, KWP II will ensure that the net effects of this project will contribute to the recovery of the covered species, and thus not contribute to cumulative impacts that may occur as a result of these other developments.

One ESA Section 10(a)(1)(B) permit for the four Covered Species has been issued through an HCP on the Island of Maui (Table 5.8). Take has also been authorized through two Safe Harbor Agreements (SHAs) on Maui (Table 5.8). Under a Safe Harbor Agreement, property owners voluntarily undertake management activities on their property to enhance, restore, or maintain habitat benefiting species listed under the ESA. These agreements assure property owners they will not be subjected to increased property use restrictions if their efforts attract listed species to their property or increase the numbers or distribution of listed species already on their property. The USFWS issues the Applicant a permit which authorizes any necessary future incidental take through Section 10(a)(1)(A) of the ESA. Accordingly, all impacts associated with these Section 10 permits have been mitigated.

Table 5.8 Take authorizations for the four Covered Species on Maui.

Permittee	Permit Duration	Location	Species Covered	No. of Permitted Take Over Permit Duration
Habitat Conservation Plan Permits				
Kaheawa Pastures Wind Energy Facility	01/30/2006- 01/30/2026	Mā'alaea, Maui	Hawaiian hoary bat	20
			Hawaiian goose	60
			Hawaiian petrel	40
			Newell's shearwater	40
Safe Harbor Agreement Permits				
Participants of USDA Farm Bill Conservation Programs	09/12/2007- 09/12/2017	Statewide	Hawaiian goose	Various
Pi'iholo Ranch	09/21/2004- 09/21/2054	Makawao, Maui	Hawaiian goose	>0

5.3.1 Hawaiian Petrel

The only other authorized take of Hawaiian petrel on Maui is at the KWP facility. Since 2006, KWP LLC has documented one observed direct take of an adult Hawaiian petrel (KWP LLC 2008b; G. Spencer, First Wind, pers. comm.). Take authorization for this species will likely be requested for the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components. Other developments on Maui with the potential to have cumulative impacts to the Hawaiian petrel include tall structures (communication towers, turbines, etc), developments with excessive lighting, and developments that decrease nesting habitat.

The proposed mitigation measures described for the Hawaiian petrel are expected to more than offset the anticipated take and contribute to recovery of the species by providing a net conservation benefit, as required by State law. Similar measures are expected for the Auwahi Wind Farm, if it is constructed. With the low expected rate of take at KWP II, the proposed mitigation measures are expected to produce a measurable net benefit in the form of a marginal increase in the population of Hawaiian petrels. For this reason, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

5.3.2 Newell's Shearwater

The only other authorized take of Newell's shearwater on Maui is at the KWP facility. To date, no take of Newell's shearwater have been observed at KWP. Take authorization for this species will likely be requested for the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components. Other developments on Maui with the potential to have cumulative impacts to the Newell's shearwater include tall structures (communication towers, turbines, etc), developments with excessive lighting, and developments that decrease nesting habitat.

The proposed mitigation measures described for Newell's shearwater are expected to more than offset the anticipated take and contribute to the species' recovery by providing a net conservation benefit, as required by State law. Similar measures are expected for the Auwahi Wind Farm if it is constructed. For this reason, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

5.3.3 Nēnē

Authorized take of nēnē is documented at several locations on Maui (Table 5.8). Since 2006, KWP LLC has documented observed direct take of three full-grown nēnē (Kaheawa Wind Power 2008b, 2009.). Since 2005, two nēnē fatalities have been documented at Pi'iholo Ranch, while 48 nēnē

have been released at this site (DOFAW 2008). No information could be found for take of nēnē as a result of the Programmatic SHA for Participants of USDA Farm Bill Conservation Programs. Other developments on Maui with the potential to have cumulative impacts to nēnē include developments that decrease nesting and foraging habitat, as well as golf courses which may attract nēnē to the area increasing their vulnerability to vehicular collisions or golf ball strikes (Mitchell et al. 2005).

Proposed mitigation measures for nēnē at KWP II are expected to more than offset the anticipated take and will contribute to the species' recovery by providing a net conservation benefit, as required by State law. Similar measures are expected for other developments on Maui with the potential to impact nēnē. For this reason, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

5.3.4 Hawaiian Hoary Bat

The only other authorized take of Hawaiian hoary bat on Maui is at the KWP facility. Since 2006, KWP LLC has documented an observed direct take of a single Hawaiian hoary bat (KWP LLC 2008b; G. Spencer, First Wind, pers. comm.). Take authorization for this species will likely be requested for the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components. Other developments on Maui with the potential to have cumulative impacts to the Hawaiian hoary bat include resort or recreational developments, farming, road construction, pesticide use, and other developments that decrease nesting and roosting habitat.

Because an accurate population estimate for this species is not available (see Section 3.8.4), it is difficult to gauge whether the take of Hawaiian hoary bat will result in a significant impact on the overall population. KWP II LLC's proposed mitigation for the anticipated take of Hawaiian hoary bat will contribute to a greater understanding of the species' status on Maui, which in turn will help guide future management and recovery efforts and result in an overall net conservation benefit for the species. Therefore, there is no anticipated cumulative impact to the Hawaiian hoary bat.

6.0 MITIGATION FOR POTENTIAL IMPACTS AND SELECTION OF MITIGATION MEASURES

The proposed mitigation program for KWP II was influenced greatly by the approved mitigation program for KWP and the data that has been collected by KWP biologists since operations commenced. In coordination with biologists from DLNR and USFWS, the Applicant will build upon the existing KWP mitigation program, or perform other appropriate mitigation measures, to achieve the biological goals and objectives identified in Chapter 4.

The following principles were followed in selecting the proposed mitigation measures:

- The level of mitigation in general should be commensurate with the level of requested take for required tier and provide a net benefit to the species;
- Mitigation should be species-specific and, to the extent practicable, location or island-specific;
- Mitigation measures should be practicable and capable of being done given currently available technology and information;
- Mitigation measures should have measurable goals and objectives that allow success to be assessed;
- The mitigation program should be sufficiently flexible to allow the allowed level of take to be adjusted as new information is obtained during project operation;
- Mitigation measures should be consistent with or otherwise advance the strategies of the respective species' draft or approved recovery plans;
- Mitigation measures that serve to directly "replace" individuals that may be taken (e.g. by improving breeding success or adult and juvenile survival) are preferred, though efforts to improve the knowledge base for poorly documented species also have merit, particularly when the information to be gained can benefit future efforts to improve survival and productivity;
- Off-site mitigation measures to protect breeding or nesting areas for birds, and roosting areas for bats, located on otherwise unprotected private land are preferred over those on public land, and sites on state land are preferred by USFWS over those on federal land;
- Measures to decrease the level of take resulting from a private activity unrelated to the project (e.g. rescue/rehabilitation of downed seabirds outside the project area as a result of disorientation by outdoor lights not related to the proposed project) may be considered; and
- Alternate or supplemental mitigation measures should be identified for future implementation if monitoring shows the level of take is found to be higher (or lower) than anticipated.

The following sections provide details of the measures proposed, and these are summarized in [Table 6.1](#). The estimated cost for each measure is presented in Appendix 6. Should alternate mitigation measures or locations be identified or otherwise become available that would present the Applicant with a greater chance of meeting the biological goals and objectives of this HCP, the Applicant reserves the right to propose such alternate mitigation instead of the measures identified below if such mitigation receives approval from the USFWS and DLNR. All mitigation measures chosen for the project will be subject to review by DLNR and USFWS over the lifetime of the project and may be discontinued, modified, or continued without modification, depending on measured levels of take and the success of mitigation measures, and as agreed upon by the Applicant, USFWS, and DLNR. As discussed, the Covered Species considered to have potential to be incidentally taken during operation of the KWP II project include the Hawaiian petrel, Newell's shearwater, nēnē, and Hawaiian hoary bat. The mitigation proposed to compensate for impacts to these species is based on anticipated levels of incidental take as determined through on-site surveys, modeling, and the results of post-construction monitoring conducted at KWP.

Table 6.1 Proposed Mitigation for Covered Species: Lower, Baseline, and Higher Take Scenarios

Seabirds	Lower	Baseline mitigation	Higher
	1. Same as baseline	Mitigation for Newell's shearwater and Hawaiian petrel at Makamaka'ole or other suitable seabird nesting sites on Maui or Kauai or elsewhere	Increased mitigation efforts at the same site or additional mitigation measures at one or more additional sites on Maui or Kauai or elsewhere
Nēnē	1. Same as baseline	<p>1. Fund the captive propagation of seven nēnē to ten goslings per year for the first three to four years of project operations for reintroduction at a suitable nēnē release site, regardless of take. Provide support for logistics, DOFAW staffing and release of goslings per same or similar cost structure as KWP.</p> <p style="text-align: center;">OR</p> <p>2a. Predator trapping on state conservation lands within and adjacent to the KWP project area and Hana'ula release site, to protect Hana'ula nene populations and increase adult and fledgling survival.</p> <p>2b. Support annual census and banding of birds by DLNR to document population trends and estimates of nesting success. Couple with in-kind field support from KWP II staff.</p> <p>2c. Develop a nēnē management plan for Hana'ula, KWP, and KWP II.</p> <p>2d. If additional mitigation is needed to provide a net conservation benefit, implement habitat improvement at Hana'ula or elsewhere near Kaheawa Pastures, as identified and recommended, (e.g. supplemental water, mowing).</p>	<p>1. Fund the captive propagation for the release of 17 more nēnē goslings for reintroduction at a suitable nēnē release facility. Provide support for logistics, DOFAW staffing, and release of goslings.</p> <p style="text-align: center;">OR</p> <p>2. Additional habitat improvement at Hana'ula or elsewhere near Kaheawa pastures, as identified and recommended (e.g. supplemental water, mowing).</p>

Table 6.1 Proposed Mitigation for Covered Species: Lower, Baseline, and Higher Take Scenarios (continued)

Hawaiian Hoary Bat	Lower	Baseline mitigation	Higher
	1. Same as baseline	<p>1a. Conduct surveys to document bat occupancy at different habitat types (e.g. ridges vs gulches) and elevational ranges at KWP II and vicinity to support Maui bat research.</p> <p>1b. \$25,000 up to a maximum of \$150,000 for management of bat habitat</p>	<p>1a. Continue surveys to document bat occupancy at different habitat types (e.g. ridges vs gulches) and elevational ranges at KWP II and vicinity to support Maui bat research..</p> <p>1b. Additional funding of \$15,000 up to a maximum of \$75,000 for management of bat habitat</p> <p>1c. Implementation of low-wind speed curtailment</p>

Possible rates of incidental take for all species discussed in this document have been identified as "Baseline," "Lower," and "Higher." These take levels were previously defined in section 5.2. Initial yearly mitigation efforts are designed to compensate for requested take at the 20-year Baseline level. Later in the project, total adjusted take as estimated through post-construction monitoring will be used to determine which tier take is occurring at and the necessary levels of mitigation required to achieve mitigation success.

The proposed seabird and nēnē mitigation will include funding measures intended to increase populations of these species. Measures intended to increase seabird population sizes will generally be aimed at eliminating predation through exclusion and/or eradication of predators from a breeding area. Reducing or eradicating predators can dramatically increase adult and juvenile survival, leading to increased productivity, (e.g. Ebbert and Byrd 2002, Pascal et al. 2008, Hu et al. 2001, Hodges and Nagata 2001), thus compensating for any individuals that may be incidentally taken by the project.

The Applicant proposes to provide mitigation for nēnē primarily either by expanding the captive propagation and release program of nēnē goslings already established for KWP or by improving survival and productivity of the existing nēnē populations at Hana'ula and the KWP project areas through predator control. This will enhance efforts to establish separate breeding populations on Maui as recommended by the Draft Revised Recovery Plan for the species (USFWS 2004).

Proposed mitigation for the Hawaiian hoary bat consists of funding studies intended to provide a better understanding of the status and distribution of the species on Maui in order to facilitate future state, federal, or private conservation and management efforts. Funding will also be provided to restore native plant habitat to increase foraging or roosting sites for the Hawaiian hoary bat. The estimated cost for each measure for the Covered Species is presented in Appendix 6. As mitigation efforts may occur on state land for any of the Covered Species, all required permits will be obtained before any mitigation measures commence.

Because authorized take of some of the Covered Species has the potential to occur early in the project, but the benefits expected from mitigation efforts would not be fully realized until some later point in time, it is possible that take could occur before mitigation measures have allowed for increases in productivity. This would result in a lag between the time of incidental take and intended replacement, possibly resulting in a slight loss of productivity by the species over that time. Therefore, the proposed levels of mitigation are also intended to compensate for possible loss of productivity by incidentally taken, sexually mature adult birds for the anticipated lag-period.

Results of post-construction monitoring will be used to determine annually whether take is occurring at Baseline or Higher rates. After the first five years, results of monitoring will also be used to determine whether take is occurring at Lower levels. In general, mitigation efforts will be adjusted to compensate for the requested take at the required tier. No adjustments to mitigation will be made to account for Lower measured levels of take until at least five years of fatality monitoring data have been collected. The Applicant will promptly coordinate with USFWS and DLNR if Higher rates of take are occurring in order to adjust mitigation efforts accordingly and, if five-year take limits are exceeded, to implement adaptive management measures. Sections 5.2.2.4, 5.2.3.4, 5.2.4.4, and 5.2.5.3 identify the rates of take that will be considered "Higher" for each species, as well as the amounts of time considered necessary to determine those rates.

6.1. WILDLIFE EDUCATION AND OBSERVATION PROGRAM

A wildlife education and observation program (WEOP) will be implemented for all regular on-site staff in order to minimize project-related impacts to listed species and other wildlife. The program will be long-term, on-going, and updated as necessary. Staff will be trained to identify listed and non-listed species of birds and other wildlife that may be found on-site, to record observations of native species protected by the ESA and/or MBTA, and to take appropriate steps when and if dead or downed wildlife is found. A plan for the WEOP is attached in Appendix 4. As part of their safety training, temporary employees, contractors, and any others that may drive project roads will be educated on speed limits, the possibility of downed wildlife being present on roads, and the

possibility of nēnē presence on the ground or flying low across roads. Personnel will be instructed to contact the Site Environmental Compliance Officer immediately if they detect any downed wildlife on-site.

6.2. DOWNED WILDLIFE PROTOCOL

The protocol for the recovery, handling, and reporting of downed wildlife will follow that developed for Kaheawa Pastures Wind Energy Generation Facility (Kaheawa Wind Power LLC, 2006) or other protocols approved by USFWS and DLNR. This protocol was developed in cooperation with DLNR and USFWS. All regular on-site staff will be trained in the protocol which will include documenting all observed mortality or injury to wildlife (including MBTA-protected birds not otherwise covered by this HCP).

Any state or federally listed species found dead or injured in the project area will be handled in accordance with the approved protocol. Injured state or federally-listed species will be photographed from a discrete distance and monitored until collection by an authorized individual. The Maui Wildlife Program manager at DLNR and the Fish and Wildlife Biologist at USFWS will be notified within 24 hours by phone and written notification will be provided within three calendar days upon discovery of any injured or dead Covered Species. All (covered and non-covered) species will be documented in accordance with approved protocols; collections will be made only by staff personnel permitted by USFWS and DLNR to handle and salvage wildlife. Injured individuals or carcasses will be handled according to guidelines in Appendix 2 of the HCP.

6.3 PETRELS AND SHEARWATERS

The major threats identified for Hawaiian petrels and Newell's shearwaters are: 1) introduced predators, which can prey on adults, eggs and fledglings; 2) feral ungulates, which degrade habitat and may trample burrows; and 3) artificial lighting, which may disorient fledglings and increase their risk of collision with artificial structures (Mitchell et al. 2005). Predation has been shown to have significant negative effects on fledging success for the Hawaiian petrel (Hodges 1994, Hu et al. 2001, Hodges and Nagata 2001, Telfer 1986) and predation on adults of both species has also been documented (Simons 1983, Ainley et al. 2001). In Haleakalā National Park, Hodges and Nagata (2001) identified predation as accounting for 41% of total terrestrial mortality (adults, fledglings, and eggs) in cases in which a cause of death could be determined. Predation mortality was attributed to cats and mongooses (38%), rats (41%), dogs (14%) and owls (6%) (Hodges and Nagata 2001). Human-related causes (road-kills, collapsed burrows, collision with structures) accounted for 49% of all mortalities, with natural causes accounting for the remaining 10%. It is expected that the causes of Newell's shearwater mortality are generally similar to those of the Hawaiian petrel due to their similar reproductive strategies and the pervasiveness of these threats.

Nesting success rates can vary greatly from year to year and are probably dependent upon many environmental factors. Data from Hodges (1994), Hu et al. (2001), and Hodges and Nagata (2001) show that predator control (trapping and fencing) generally results in a significant increase in Hawaiian petrel nesting success as shown in Table 6.2.

In addition to the identified threats, a major factor limiting the ability to manage Hawaiian petrel and Newell shearwater colonies is their remoteness, which makes ungulate and predator management difficult (Mitchell et al. 2005). Nesting areas that are more accessible may also be difficult to protect if the nesting is highly dispersed (Podolsky and Kress 1992). One method for increasing protection is by attracting first-time breeders to new colonies in accessible areas or increasing seabird densities at existing colonies that are well situated for management. Seabird attraction to specific areas can be achieved by broadcasting audio play-backs of vocalizations of conspecifics. This technique has been shown to work on a wide range of species of seabirds (Gummer 2003), including the Galapagos petrel (*Pterodroma phaeopygia*, Podolsky and Kress 1992), which is closely related to the Hawaiian petrel, the Laysan albatross (*Phoebastria immutabilis*, Podolsky 1990), which also breeds in Hawaii, and the Bermuda petrel (*Pterodroma cahow*, Dobson and Madeiros 2009). Ground-nesting seabird species can be encouraged to nest at a prospective site by the placement of artificial burrows accompanied by vocalization play-backs.

This then increases the density of nesting pairs in the area which in turn allows for more effective management (Podolsky and Kress 1992). Artificial burrows may also be positioned in a manner that facilitates monitoring. So far, the use of artificial burrows has been attempted with some success for Newell's shearwaters at Kilauea Point National Wildlife Refuge on Kaua'i (Joyce et al. 2008, U.S. Fish and Wildlife unpubl. data). These techniques have shown considerable success for an increasing number of ground-nesting seabird species at several locations in the Pacific and Atlantic Oceans. The Action Plan for Seabird Conservation in New Zealand states that colony establishment and enhancement is expected to contribute long-term conservation benefit to threatened seabird taxa (Taylor 2000a, b). According to Hawaii's Comprehensive Wildlife Conservation Strategy, while protecting seabird populations and their breeding colonies remains an important management priority, re-establishing former (or even remnant) breeding colonies is also important to reduce the risk of eventual extinction (Mitchell et al. 2005).

Table 6.2 Comparison of Hawaiian Petrel Nesting Success (Percent Nests that Successfully Fledged a Chick) With and Without Predator Control.

Location	Year(s)	Nesting success (%)		Reference
		W/o predator control	W/ predator control	
Haleakala, Maui		42.0	57.0	Hodges 1994
Mauna Loa, Hawaii	1995-96	41.7	61.5	Hu et al. 2001
Haleakala, Maui	1982	0.0	32.7	Hodges and Nagata 2001
Haleakala, Maui	1990	10.0	49.2	Hodges and Nagata 2001
Haleakala, Maui	1991	25.6	48.6	Hodges and Nagata 2001
Haleakala, Maui	1992	15.2	17.0	Hodges and Nagata 2001
Haleakala, Maui	1993	32.8	38.2	Hodges and Nagata 2001
Haleakala, Maui	1994	44.0	23.0	Hodges and Nagata 2001
Haleakala, Maui	1995	31.8	50.0	Hodges and Nagata 2001
Haleakala, Maui	1996	28.1	46.7	Hodges and Nagata 2001
Unweighted Average		27.1	42.4	

Mitigation for seabirds takes into account the expected annual rate of direct and indirect take. Replacement for take of adults or juveniles will include replacement by either increased adult survival or increased fledging success. If a decrease in adult predation at the nesting sites can be demonstrated, then it should be possible to replace a taken adult directly with another adult. However, when replacement is provided by fledglings, the rate of survival to adulthood will be taken into account to ensure that a sufficient number of fledglings reach adulthood to replace those adults incidentally taken. Juvenile survival rates to adulthood are assumed to be 30% for the Hawaiian petrel (Simons and Hodges 1998) and 24% for Newell's shearwater (Ainley et al. 2001).

As adults may be taken anytime during the breeding season, indirect take can consist of eggs, chicks or fledglings (see Table 5.2). Since mitigation will be quantified in terms of the number of fledglings produced, the expected survival rates of eggs or chicks to the fledgling life stage is also taken into account (Table 6.3).

Table 6.3 Fledgling requirements for the indirect take of Hawaiian petrel and Newell's shearwater eggs, chicks and fledglings

Hawaiian petrel	Season	Indirect take	Age class	Assumed survival rates to fledging	Fledglings required
Adult	May-Aug	0.89	chick/egg	--	0.424*
Adult	Sept	1	chick	1	1
Adult	Oct	0.5	chick	1	0.5
Adult	Nov - Apr	0	--	--	--
Immature	All year	0	--	--	--

*data in this instance is not calculated from the indirect take assessed but values from Table 6.2 above are used instead

Newell's shearwater	Season	Indirect take	Age class	Assumed survival rates to fledging	Fledglings required
Adult	Jun-Aug	0.46	chick/egg	0.66**	0.31 (=0.66 x 0.46)
Adult	Sept-Oct	1	fledgling	1	1
Adult	Nov - May	0	--	--	--
Immature	All year	0	--	--	--

** data from Ainley et al. (2001)

In addition, because Hawaiian petrels and Newell's shearwaters mature at age 5 and 6 years, respectively, mitigation also takes into account the loss of offspring that may have been produced by taken adults during the time that it takes for replacement fledglings to reach sexual maturity. The loss of productivity is calculated based on the percentage of the adult population breeding per year, yearly adult survivorship, and the reproductive success of a pair or individual (see Appendix 5 for life history details). At the suggestion of USFWS, it is assumed that it could require up to two years for a bird that has lost its mate to a collision event to find a new mate and begin reproducing again. Therefore, in calculating lost productivity, for each of the first two years following an incidental take, lost reproductive success is assumed to be the average annual productivity of a pair. In subsequent years, lost productivity is assumed to be half that rate (i.e., the lost production attributable to the taken individual as its former mate by then will be assumed to again be breeding with a new mate).

Mitigation for seabirds outlined in section 6.3.1 is likely to be a combined effort between three wind facilities, KWP II, KWP and Kahuku Wind Power⁹. Tables 6.4 lists an example of how many adults and fledglings may be expected to accrue after seven or eight years of mitigation effort for Hawaiian petrels or Newell's shearwater. This example presumes that the area encompasses 100 burrows of each species and the yearly number of fledglings accrued is the difference in nesting success between areas with predator control and without. The values of nesting success for Hawaiian petrels from Table 6.2 are used to calculate the expected long-term fledgling accrual rate for both Covered Species. No equivalent information currently exists for Newell's shearwater. These values for either species, but particularly for Newell's shearwater can be adjusted as more information becomes available over time. An increase in adult survival rates of 1.5% is also assumed based on best available information (Ainley et al. 2001) for both species. In the example below, adult predation is assumed to occur at 2.0% at an unmanaged site and at 0.5% at a managed site.

⁹ Kahuku Wind Power, an O'ahu wind power generation project, is authorized for the incidental take of Hawaiian petrel and Newell's shearwater, among other species.

Table 6.4 Expected Results after 7 or 8-years of Baseline Mitigation for Either Hawaiian Petrel or Newell's Shearwater

Fledgling accrual		Adult accrual	
No. of burrows	100	No. of burrows	100
A. Yearly fledgling production at unmanaged area (27.1% nest success)	27.1	No. of adults in area	200
B. Yearly fledgling production at managed area (42.4% nest success)	42.4	D. Yearly adult mortality at unmanaged site (assumed 2%)	4
C. Fledglings accrued yearly (=B-A)	15.3	E. Yearly adult mortality at managed site (assumed 0.5%)	1
		F. Adults accrued yearly (=D-E)	3
Fledglings accrued after 7 years (=C x 7)	107.1	Adults accrued after 7 years (=F x 8)	21
Fledglings accrued after 8 years (=C x 8)	122.4	Adults accrued after 8 years (=F x 8)	24

Table 6.5 below lists the mitigation targets required to compensate for the Baseline requested direct take of 44 Hawaiian petrels in total for all three wind facilities, after factoring in indirect take, and loss of productivity. KWP II has a requested direct take of 20 individuals, KWP, 20 individuals and Kahuku Wind Power 4 individuals. Finally, this example also assumes same-year replacements for the direct take of adults and indirect take of young.

Based on calculations from Table 6.4, eight years of mitigation efforts should yield 122 fledglings and 24 adults. Therefore, of the 44 adults/immatures, 24 would be replaced directly by adults, requiring 91 fledglings to replace the remaining adults and immatures, account for indirect take and loss of productivity. Mitigation efforts for eight years should therefore meet the Baseline requested take for Hawaiian petrels for all three projects with an excess of approximately 30 fledglings.

Table 6.5 Fledglings Required for Baseline Mitigation for the Hawaiian Petrel for all Three Projects Combined Assuming 8-Years of Mitigation Effort

	Adult (March - April)	Adult (May-Aug)	Adult (Sep)	Adult (Oct)	Fledglings (Nov)	Total
Expected distribution of direct take ¹	10.00	20.00	5.00	5.00	4.00	44.00 adults/ fledglings
Direct take replaced by adults	4.00*	20.00*	0.00	0.00	0.00	24.00 adults ⁶
Direct take not replaced by adults	6.00	0.00	5.00	5.00	4.00	20.00 adults
Fledglings required for direct take ²	20.00	0.00	16.67	16.67	4.00	57.33 fledglings
Indirect take	0.00	17.80 eggs /chicks	5.00 fledglings	2.50 fledglings	0.00	
Indirect take converted to fledglings ³	0.00	8.48 (=20x0.424)	5.00 (=5x1)	2.50 (=2.5x1)	0.00	15.98 fledglings
Loss of productivity (Yr 1-2) ⁴	4.21	0.00	3.51	3.51	0.00	11.23 fledglings
Loss of productivity (Yr 3-4) ⁵	2.11	0.00	1.75	1.75	0.00	5.62 fledglings
Total fledglings required						91 (=90.16)

¹Distribution of direct take = total direct take (44)/no. of months in period

²Fledglings required for direct take = Adults/survival rate of fledglings to adulthood (0.3)

³See Table 6.3 for conversion factors

⁴Loss of productivity (Yr 1-2) = probability of breeding (0.89) x adult yearly survival (0.93) x reproductive success of a pair (0.424) x 2 years
– the reproductive success of an adult taken is assumed to come from a managed colony

⁵Loss of productivity (Yr 3-4) = probability of breeding (0.89) x adult yearly survival (0.93) x reproductive success of an individual (0.212) x 2 years
– the reproductive success of an adult taken is assumed to come from a managed colony

⁶ From Table 6.4 (adults accrued after eight years of mitigation).

*The assignment of which adults are replaced by adults is arbitrary and independent of when the take occurs.

A similar example is presented below for Newell's shearwater. The three projects have a Baseline requested **total direct take** of 38 Newell's shearwaters in total (20 individuals for KWP, ten for KWPII and eight for Kahuku Wind Power. This example also assumes that the area protected encompasses 100 burrows with an increase in adult survival rates of 1.5%. Adult predation is assumed to occur at 2.0% at an unmanaged site and at 0.5% at a managed site. As little information is currently available as to the changes in productivity at managed and unmanaged sites for Newell's shearwater, the same values for the Hawaiian petrel are applied to this example. Finally, this example also assumes same-year replacements for the direct take of adults and indirect take of young.

Table 6.6 Fledglings Required for Baseline Mitigation for the Newell's Shearwater for all Three Projects Combined Assuming 7-Years of Mitigation Effort

	Adult (April - May)	Adult (June- Aug)	Adult (Sept-Oct)	Fledglings (Nov)	Total
Expected distribution of direct take ¹	9.00	14.00	10.00	5.00	38.00 adults/fledglings
Direct take replace by adults	7.00	14.00	0.00	0.00	21.00 adults
Direct take not replaced by adults	2.00	0.00	10.00	5.00	17.00 adults
Fledglings required for direct take ²	8.33	0.00	41.67	20.83	70.83 fledglings
Indirect take	0.00	6.44 eggs/chicks	10.00 chicks	0.00	
Indirect take converted to fledglings ³	0.00	4.25 (=6.44*0.66)	10.00 (=10x1)	0.00	14.25 fledglings
Loss of productivity (Yr 1-2) ⁴	0.70	0.00	3.51	1.76	5.97 fledglings
Loss of productivity (Yr 3-5) ⁵	0.53	0.00	2.63	1.32	4.48 fledglings
Total fledglings required					82 (=81.28)

¹Distribution of direct take = total direct take (38)/no. of months in period

²Fledglings required for direct take = Adults/survival rate of fledglings to adulthood (0.24)

³See Table 6.3 for conversion factors

⁴Loss of productivity (Yr 1-2) = probability of breeding (0.46) x adult yearly survival (0.90) x reproductive success of a pair (0.424) x 2 years
– the reproductive success of an adult taken is assumed to come from a managed colony

⁵Loss of productivity (Yr 3-5) = probability of breeding (0.46) x adult yearly survival (0.90) x reproductive success of an individual (0.212) x 3 years
– the reproductive success of an adult taken is assumed to come from a managed colony

⁶ From Table 6.4 (adults accrued after seven years of mitigation)

Based on calculations from Table 6.4, seven years of mitigation efforts should yield 107 fledglings and 21 adults. Therefore, of the 38 adults, 21 would be replaced directly by adults, requiring 82 fledglings to replace the remaining adults, account for indirect take and loss of productivity. Mitigation efforts for seven years should therefore meet the Baseline requested take for Newell's shearwater for all three projects with an excess of approximately 25 fledglings.

6.3.1 Baseline Mitigation

It is proposed that Baseline mitigation for both seabird species will consist of predator trapping or habitat and colony enhancement at a seabird colony on Maui, Kaua'i or elsewhere. Currently, the preferred mitigation site is situated on West Maui at Makamaka'ole. A Hawaiian petrel colony was found in West Maui near lower Kahakuloa Valley (called the Makamaka'ole colony) during the implementation of the Kaheawa Wind Power HCP. The presence of Hawaiian petrels was corroborated by DLNR wildlife biologists from Maui and seabird researchers from the USGS and H.T. Harvey and Associates in early July 2007 (Kaheawa Wind Power LLC, 2008). Newell's shearwaters have also been heard calling overhead (Spencer pers. comm.) at this site. This seabird colony is close to existing development (which increases the likelihood of cats and human disturbance), is accessible, and therefore highly likely to benefit from management. This seabird colony, located on State Forest Reserve land, is currently managed by Kaheawa Wind Power which initiated a predator trapping program in 2009 to reduce cat and mongoose populations in the vicinity (Kaheawa Wind Power 2009).

As described below, several alternatives have been developed for KWPII to complement the management activities occurring at this seabird colony.

6.3.1.1 Alternative 1 for Baseline Mitigation

Discussions with ESRC, USFWS and DOFAW have led to a recommendation that KWPII, KWP, and Kahuku Wind Power pool resources and implement a comprehensive plan for seabird colony management at Makamaka'ole. Collectively, KWP II, KWP, and Kahuku Wind Power would pool funding to implement a fencing (and if needed a social attraction) project (Appendix 11). The area to be fenced shall have the potential to encompass the target number of burrows to meet the Baseline mitigation requirements for all three projects. The number of burrows needed will ultimately be determined in concurrence with USFWS and DLNR and will depend on the number needed to offset the requested Baseline take within a pre-determined number of years within the 20-year duration of the project (see above for an example). The shorter the time period, the greater the number of burrows will be required. The actual number of burrows required will be determined using a reproductive output and survival model currently being developed for the Hawaiian petrel (Fretz pers. comm.).

The cat-proof fence will be approximately 1.6 – 2 miles (2.6 – 3.2 km) long and at least 1.8m (5.9 ft) high, the actual length, height and location of the fence and the size of the enclosed area will be determined in concurrence with USFWS and DLNR. Ideally the identified area will have enough naturally occurring burrows to meet the Baseline mitigation requirements. The Applicant will coordinate closely with USFWS and DLNR to conduct site feasibility assessment within the first year of permit issuance. KWP will also revise the existing Makamaka'ole Mitigation Plan and submit the plan as part of the feasibility analysis. The fencing and subsequent predator control will only be implemented if the results of the feasibility assessment are indicative of a high probability of being able to meet the net conservation benefit requirement for all three projects via the specified measures. A decision will be made by September 1, 2010 whether to fence the specified area.

If a decision is made to construct the fence, all applicable permits will be obtained and the fence will be constructed as soon as practicable and preferably commencing within the first year of project operation. However, installation of fencing will only be conducted during the non-breeding season of the two Covered seabird species. Following the erection of the fence, cats and mongoose will be eradicated within the area, and rat populations will be controlled. Cat, rat and mongoose activity will be monitored within the fenced area using track pads and other suitable methods. Monitoring will also be conducted to document the effects of reduced predation on seabird survival and productivity within the enclosure.

If insufficient naturally occurring burrows are found within the fenced area, the Applicant will consult with USFWS and DLNR to determine the most appropriate action. One alternative is to implement social attraction techniques for both Covered seabird species within the fenced area to increase the number of active burrows. Social attraction will consist of broadcasting vocalizations

of nesting Hawaiian petrels and/or Newell's shearwaters (whichever is needed) during the prospecting and breeding season to encourage nesting within the area. Artificial burrows would be installed to increase available nesting habitat. Natural and artificial burrows would be monitored to document the success of the social attraction study.

If the fencing and social attraction study is deemed successful by USFWS and DLNR, the fence will be maintained throughout the life of the three projects and monitoring in the enclosure for cats and mongoose will continue and these species will be re-eradicated if they are found to have breached the fence. Continued management beyond Baseline mitigation requirements will be determined in consultation with DLNR and USFWS and may consist of third-party management or a cooperative effort between DLNR, the participating wind facilities and other interested parties.

If the social attraction and fencing study is deemed to be unsuccessful, mitigation efforts up to that point will be sufficient to meet the Baseline requested take of all three projects (see section 6.3.5).

The actual measures implemented at Makamaka'ole will be determined in concurrence with DLNR, USFWS, KWP II, KWP and Kahuku Wind Power. Input will be sought from the Seabird Recovery Group for the State of Hawai'i. However, if mitigation efforts at another seabird colony are identified as a greater need or having a greater potential benefit, priority will be given to other colonies on East Maui, West Maui or Kaua'i or in other areas as determined by DLNR and USFWS.

6.3.1.2 Alternative 2 for Baseline Mitigation

Another possible mitigation alternative is to participate in the management of the Hawaiian petrel colony breeding in the crater of Haleakala. This alternative also has the potential to be a combined effort of KWP II with KWP and Kahuku Wind Power. This site has the largest known breeding colony of Hawaiian petrels (USFWS 2005, Hodges and Nagata 2001) with over 1,000 known nests in and around Haleakala Crater. The National Park Service has indicated that an approximately 220 ac. (89 ha) area with approximately 100 burrows are protected from habitat damage by feral goats and pigs, but are not protected from predators. The National Park Service does not have funds to conduct the needed predator control in this area and does not anticipate receiving funds in the near future (Bailey pers. comm.). If KWP II participates in the management effort with KWP and Kahuku Wind Power, the three entities will contract the labor and purchase equipment (e.g., traps and bait) required to conduct predator trapping in this area (or a section thereof, depending on mitigation requirement), and to conduct monitoring to document success. Trapping and monitoring protocols will closely follow the protocols that have already been established by the National Park Service for managing the rest of the colony (Hodges and Nagata 2001). This effort would run for an initial period of eight years (see Tables 6.4 and 6.5). If after the initial eight years of predator trapping, mitigation is still not at least one fledgling above Baseline requested take for all three projects, mitigation will continue until that is achieved (see section 6.3.5 below). The limits of the area to be treated, need for additional years of treatment and other details of the mitigation efforts will be decided with concurrence of the National Park Service, DLNR and USFWS.

As Alternative 2 for Newell's shearwater, KWP II proposes to provide support for colony-based protection and productivity enhancement on Kaua'i. This may involve supplementing an island-wide HCP developed for the island of Kauai in proportion to the authorized take and any loss of productivity that may occur in the interim. If the island-wide HCP does not come into fruition within 3 years, then colony-based mitigation will be implemented, either by KWPII alone or as part of a cooperative effort with another entity. Several known colonies on Kaua'i presently receive little or no management attention, and it is likely that other colonies remain to be discovered. The site chosen by KWP II for colony-based mitigation would be selected with the concurrence of the DLNR and USFWS. It is likely that KWP II, KWP and Kahuku Wind Power will also collaborate for this mitigation effort. KWP II would either support an existing conservation need at a known colony or direct mitigation at a newly discovered colony where no management presently exists. The success of the mitigation efforts of KWP II will be measured using the method that is currently implemented at that site at the time. If the chosen mitigation site was previously unmanaged, the same measures of success used to estimate success at managed sites will be applied as

appropriate. Funding has been provided in the budget to allow for the maximum cost scenario, i.e., providing mitigation for petrels at Haleakala National Park, and colony protection and management for Newell's shearwaters on Kauai.

6.3.2 Mitigation for Higher Rates of Take

If the mitigation efforts for KWP, KWPII and Kahuku Wind Power are combined, it is proposed that mitigation for a Higher rate of take only be required if the total adjusted take for the three projects combined exceed the combined requested Baseline take level of all three projects for either seabird species. In the event the three projects do not collaborate and mitigation efforts are conducted independently, then mitigation for a Higher rate of Take will be required if the 5-year or 20-year Baseline requested take for the KWP II is exceeded for either species. If take occurs at a Higher level, the Applicant, USFWS, and DLNR will first consider whether the mitigation efforts being provided under the existing programs described above are sufficient to offset requested take at the Higher tier. Such decision would be based on the total amount of take that has occurred up to the time that the Higher rate of take is identified, success of the mitigation measures, and the point in time at which the Higher rate of take is identified.

If Baseline mitigation measures are insufficient to compensate for the Higher rate of take, then additional mitigation will be provided through additional funding or in-kind services. KWP II (with KWP and Kahuku Wind Power, if working in collaboration) will increase the amount of funding provided for fencing and predator control efforts or other mitigation measures. Additional funding could be used to increase mitigation efforts at the chosen site or implement mitigation measures at additional sites on Maui, Kaua'i or elsewhere. Selection of additional sites, identification of the appropriate mitigation initiatives, and level of effort will be determined in consultation with DLNR and USFWS.

6.3.3 Additional Research to Improve Avoidance and Minimization Measures at Higher Rates of Take

If Higher rates of take are found to occur annually and persist for more than three consecutive years, the Applicant will conduct on-site investigations in an effort to determine the cause(s) of the unexpectedly higher levels of take, and to identify and implement measures, where practicable, to reduce take levels. On-site investigations may include, but will not necessarily be limited to, additional surveys using radar, night-vision, thermal imaging, or newer state-of-the-art technologies, as appropriate, to document bird movements and behavior during periods when collisions are believed to be occurring, and particularly to determine whether certain turbines, seasonal or other site-specific conditions account for greater mortality. Investigations may also include experimental changes in project operations, and experimental measures to divert or otherwise repel birds from the area. Measures to reduce and minimize further take could include, but would not be limited to, implementing permanent changes in project operation, moving structures that cause a disproportionately high amount of take, and implementing methods to divert or repel birds from project facilities. Determining the appropriateness of any such measures would take into account costs and practicability.

6.3.4 Mitigation for Lower Rates of Take

If rates of take have not already been identified as occurring at Higher rates, a determination will be made whether take of seabirds is occurring below Baseline levels. A Lower rate of take will be determined for KWP II, KWP and Kahuku Wind Power if the total adjusted take is collectively are lower than the combined Lower requested rate of take after five consecutive years of project operation. In the event the three projects do not collaborate and mitigation efforts are conducted independently, then a Lower rate of Take will be assessed for KWPII if the total adjusted take for a consecutive 5-year period is less than or equal to the KWP II 5-year requested take for the Lower tier for either seabird species.

If mitigation occurs at Makamaka'ole (see Alternative 1 in Section 6.3.1.1), and fencing and trapping is proceeding as planned, no change in mitigation will be implemented even if take occurs

at a Lower level. However, if mitigation obligations are deemed to have been met at that point in time, mitigation efforts may cease with the concurrence of DLNR and USFWS.

If Alternative 2 (see section 6.3.1.2) is chosen and mitigation is already commensurate with the Baseline requested take, mitigation obligations will have been met and may cease with the concurrence of DLNR and USFWS. If take returns to Baseline or Higher levels, mitigation may resume if required by DLNR and USFWS.

6.3.5 Measures of Success

Mitigation efforts provided by KWP II will contribute to habitat and colony enhancement, and the control of predator populations and thus will provide a net benefit to, and aid in the recovery of, the two seabird species.

Strictly speaking, mitigation will be deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. In practice, however, mitigation measures are likely to provide much greater net benefits. For Alternative 1, these mitigation requirements may be met if sufficient burrows are fenced and enough fledglings and adults are accrued to exceed the requested take level requirements. Fledglings accrued will be the net increase in pair productivity of each seabird species over that of baseline productivity estimates for each seabird species under unmanaged conditions using best available information. Likewise, the adults accrued will be the difference in adult survival rates at the managed site over that under unmanaged conditions. Unmanaged conditions will be represented using the best available information from published studies of the same or similar species with the concurrence of DLNR and USFWS.

However, as decided with prior concurrence with DLNR and USFWS, even if the conservation at Makamaka'ole does not replace more Newell's shearwaters or Hawaiian petrels than authorized, the value of completing a social attraction study will still be considered a net benefit to the Covered seabird species due to the inherent value of the knowledge gained for seabird conservation actions. This is so because, while social attraction methods appear to hold great promise, they have not been proven in Hawaii, and the results from these mitigation efforts will assist in determining the next steps to take to promote the recovery of the Hawaiian petrel and Newell's shearwater.

If Alternative 2 is chosen, mitigation will be deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. If the mitigation is conducted within a shorter time frame than the project lifetime, models will be used to demonstrate whether the mitigation provided will result in a net benefit for the species at the appropriate tier for the entire permit term. The model will be chosen with the concurrence of KWP II, USFWS and DLNR.

To further ensure the success of the mitigation effort, the Applicant will establish a \$160,000 Seabird Contingency Fund that will be made available prior to construction of the proposed turbines. The value of the fund will be adjusted at 2.5% over the 20-year term of the HCP. This would result in a total maximum of \$262,179 (if left unused through Year 20). If drawn upon at any time, the 2.5% would continue to accrue on the remaining balance. The fund will be available to implement adaptive management strategies to ensure mitigation is commensurate with the requested take of the required tier. If at the end of the 20-year period the mitigation implemented is not commensurate with the requested take of the required tier, any remaining funds will be used to continue to implement mitigation measures.

In addition, past, current or future funds allocated to other Covered Species may be expended where necessary to provide for the cost of implementing HCP mitigation measures for a particular species as long as the overall expenditure for mitigation at the Baseline tier (excluding contingency funds) does not exceed a total of \$2.489M. While KWP II will not be required to expend more than \$2.489M (excluding contingency funds) to fulfill its mitigation obligations at the Baseline tier for the Covered Species, funding for any individual Covered Species is not limited to those amounts estimated in Appendix 6. KWP II also recognizes the cost of implementing

mitigation measures in any one year may exceed that year's total budget allocation, even if the overall expenditure for mitigation stays within the total amount budgeted over the life of the project. Accomplishing these measures may therefore require funds from future years to be expended, or likewise unspent funds from previous years to be carried forward for later use. Reallocation of funds among years may require up to 18 months lead time in order to meet revenue and budgeting forecast requirements.

6.4 NĒNĒ

KWP biologists maintain an ongoing collaboration with biologists from DLNR and USFWS, as well as regional experts, to identify, select, and implement appropriate measures to mitigate for take of nēnē under the terms of the KWP HCP. Several provisions in the KWP HCP guide mitigation for nēnē. A similar approach is proposed for the KWP II project, with the intention of providing a net ecological benefit to the species in alignment with state and federal species recovery goals. The Applicant will provide support for nēnē population protection and/or enhancement or nēnē propagation and release, which may include translocation. The estimated cost for each proposed measure is presented in Appendix 6. All proposed measures are intended to promote the recovery of the species within portions of its historic range.

6.4.1 Avoidance and Minimization Measures

The following measures will be employed to avoid and minimize the potential for construction and operation of the proposed project to adversely affect nēnē (see Appendix 12):

- Surveys will be performed in areas to be cleared for project construction to ensure that no active nēnē nests would be disturbed or destroyed by vegetation clearing activities;
- Areas temporarily disturbed during construction of the KWP II project will be re-vegetated in consultation with DOFAW Biologists to ensure that nēnē will not be attracted to areas where they would be at increased risk of adverse impacts from project operation (however, planting vegetation favorable for nēnē in selected areas may be considered beneficial to the species), or create a fire hazard; and
- Similarly, any ongoing management of vegetation in the project area such as mowing, clearing or future planting will be conducted in consultation with DOFAW biologists to ensure that nēnē will not be attracted to areas where they would be at increased risk of adverse impacts from project operation.

6.4.2 Baseline Mitigation

Mitigation for nēnē will take into account the expected annual direct and indirect take of the species, as well as any loss of productivity that might occur. Mitigation for any direct take of adults and direct or indirect take of goslings or fledglings will be provided through replacement by fledglings and possibly adults. However, when adults are replaced by fledglings, the survival rate of fledglings to adulthood will be taken into account in determining the number of fledglings needed to offset expected levels of take of adult birds.

In addition, because female nēnē mature at age three and males at age two (Banko et al. 1999), the proposed mitigation will also need to account for possible loss of production during the lag years between take of adult birds and the sexual maturity of fledglings. For the purposes of this HCP the take of a mature female will require accounting for two years of possible lost productivity (an adult lost in Year 1 would be replaced by fledglings in Year 1, with indirect take separately accounted for, no gosling production would occur in Year 2 and 3 because the birds released in Year 1 are still immature; in Year 4 the now adult female released as goslings a gosling in Year 1 could begin reproducing). Only one year of loss of productivity will be attributed for the take of a mature male.

Average loss of productivity through mortality of one adult has been determined to be 0.09 goslings/individual/year (see Section 5.2.4.2). The mortality rate of captive-reared released

goslings to Year 1 was reported to be 16.8% for females and 3% for males (Hu 1998, Banko et al. 1999). For the purposes of this HCP, an annual mortality rate of 17% is assumed to occur for both genders of geese through maturity (age two or three depending on gender). Male and female nēnē are assumed to be equally vulnerable to collision with the turbines and associated structures. Table 6.7 identifies the number of fledglings that will be required to be released to offset the Baseline level of take anticipated for nēnē during operation of the KWP II project. It is anticipated that all take will be replaced with fledglings within the same year or earlier. If increased adult survival can be demonstrated, the estimate can be adjusted accordingly.

Two mitigation alternatives for the Baseline level of take are proposed in this HCP. The alternative chosen for implementation will be decided in consultation with DLNR and USFWS and will be based upon the strategy that is practicable, will most effectively meet mitigation requirements, and best complement the recovery plans for the species.

Table 6.7 Baseline mitigation required for nēnē assuming same year replacement

	Direct take		Indirect take	Total fledglings required
	Male	Female	Fledglings	
Total requested Baseline take	9	9	2	
Fledglings required	13.1 (=9/0.83/0.83)	15.7 (=9/0.83/0.83/0.83)	2	30.8
Loss of productivity	0.09 (=0.09 x1 year)	0.18 (=0.09 x 2 years)		0.3
Grand total				31.1

6.4.2.1 Preferred Baseline Mitigation Measure

Based on the numbers provided in Table 6.7, if take of nēnē at the KWP II facility occurs at Baseline level over the 20-year life of the project (take of 18 adults and two fledglings), this would require 32 fledglings total as compensation for Baseline requested take. The preferred Baseline mitigation for nēnē is proposed to consist initially of providing funding (\$18,000 up to \$44,000 per year) to DLNR for the propagation and release of seven to ten goslings annually for the first three to four years of project operation (up to 35 goslings total). These costs are based on an estimate of \$75,000 per year required to run the nēnē breeding facility, with a annual production of 15-25 goslings (MBCC staff, pers. comm.). The cost of gosling production will be shared with KWP; this facility is also obligated to release goslings as part of their mitigation.

Discussions with breeders at the Maui Bird Conservation Center (MBCC) have indicated that goslings are released at around 10 weeks of age, and are close to or at the point of fledgling. Barring health issues, all goslings introduced into the release pen are expected to fledge, thus a release of ten goslings per year would be equivalent to providing mitigation of ten fledglings for that year. The release would occur at a suitable off-site release pen on Maui as decided with concurrence of USFWS and DLNR. It is assumed that KWP will be providing for release of goslings at this same pen and the funding for the construction of the pen and transportation of personnel, and staffing has already been committed by KWP.

KWP II however will support additional staffing, and management of the released birds by contributing

- \$5,000 per year toward staffing operations, maintenance personnel and predator control at the nēnē release facility for up to five years of operation to supplement the staffing contributions of KWP (total of \$20,000 a year for both projects); and

- \$2,000 per year toward use of a helicopter to carry each year's set of goslings to the release site.

Currently, the preferred release site for goslings for both KWP and KWPII is the release pen at Haleakala Ranch. A pen is being built and releases are expected to begin as early as 2011. The target release number at Haleakala Ranch is 75 goslings, which is expected to increase to a self-sustaining population of 200 individuals over time (MBCC staff, pers. comm.). KWP is obligated to release 50 goslings, leaving KWP II 25 goslings for their mitigation efforts. Based on the numbers provided in Table 6.7, at least 32 fledglings are required for KWP II to mitigate for their Baseline requested take, seven fledglings more than would be released at the pen. Since KWPII and KWP are also contributing to staffing and predator control for the first five years, it is anticipated that these seven fledglings will be accrued over five years by the increased reproductive success of the released goslings that have matured and bred successfully within the managed area. The fledglings accrued would be the difference in productivity between a managed and unmanaged area. If monitoring indicates that insufficient fledglings have accrued after the first five years, funding will be provided for up to three additional years of predator control efforts at the same release site till the target number of fledglings needed are met. In this instance, KWPII will cover the full cost of staffing (\$20,000 per year).

Should circumstances change and gosling release at the chosen release pen no longer is a viable option, KWP is already obligated to provide funding to construct a second nēnē release pen on Maui, Moloka'i, or Hawai'i as determined in consultation with DLNR and USFWS. The remainder of the goslings proposed to be released by KWPII would then be released at the new location. KWPII will use the remaining funding outlined above to provide for transportation of goslings, predator control and maintenance of the pen at this new location.

6.4.2.2 Alternate Baseline Mitigation Measure

The alternate Baseline mitigation measure for KWP II consists of on-site and near-site mitigation to enhance the existing nēnē population at Hana'ula and Kaheawa Pastures. Mitigation efforts are targeted at addressing two of the seven recovery goals as identified in the "Draft Revised Recovery Plan for the Nēnē or Hawaiian Goose (*Branta sandvicensis*)" and are quoted below:

"2) Manage habitat and existing populations for sustainable productivity and survival complemented by monitoring changes in distribution and abundance;

3) Control alien predators which addresses control of introduced mammals to enhance nēnē populations"

Staff at KWP II working with DLNR will develop a nēnē management plan for nēnē present at Hana'ula, and the KWP project area within the first year of permit issuance or prior to starting operation of the project, whichever is later. Yearly funding (\$15,000/year) for the first 5 years will be provided to DLNR to support personnel that will conduct an annual census, band nēnē adults and fledglings, and quantify reproductive success at Hana'ula and the Kaheawa Pastures area. Predator control measures (\$18,000 per year) will commence in Year 1 or 2 of project operation, depending on the availability of a baseline to establish nēnē productivity and adult survival in the absence of predator control. In the event that baseline data on nēnē reproductive success and adult and juvenile survival are not already available, mitigation efforts will be delayed one year and the first year of nēnē monitoring and banding data collected will be used as a baseline. Alternatively, productivity and adult survival from another unmanaged site with similar habitat characteristics will be used as a baseline if available and considered suitable by USFWS and DLNR. The baseline will be used to measure the effectiveness of predator control in increasing adult and juvenile survival and productivity. The number of fledglings or adults accrued above the baseline productivity will count towards the mitigation requirements of KWP II. Data from all years will also be used to document population trends and identify emerging and existing threats.

Predation has been identified as a main limiting factor in the recovery of nēnē (Banko et al. 1999). At Haleakala National Park, adults were predated upon by cats, dogs, and mongoose (Banko et al. 1999). Adults were particularly vulnerable to predation while incubating, tending to goslings, and while molting. Cats, mongoose, and rats preyed upon goslings and nests were visited and eggs removed by mongoose and rats. Predator control of rats at Haleakala National Park resulted in declines in egg predation, where at the Palika site 63% of nests (12 of 19) were predated prior to control from 1993 to 1994, while only 18% of nests (3 of 17) were predated following control from 1994 to 1995 (Baker and Baker 1995). The reduction in rat predation was attributed to the trapping and diphacinone poisoning conducted at the park. Exclusion of mammalian predators has similarly increased nesting success of nēnē at Volcanoes National Park, Hawai'i. Mongoose have also been documented causing significant nesting failures of wild nēnē on the Islands of Hawai'i and Maui (Hoshida et al. 1990, Banko 1992, Black and Banko 1994, Baker and Baker 1999). All the species of alien mammal predators mentioned above are believed present at Hana'ula and the Kaheawa Pastures area. Proposed predator removal measures may consist of deploying traps, leg holds, and/or snares or broadcasting rodenticide. These measures are expected to significantly improve adult and juvenile survival and increase productivity of nēnē pairs commensurate with the Baseline level of requested take and provide a net benefit to the species.

Should on-site monitoring identify a more pressing threat to the survival of nēnē at Hana'ula and the Kaheawa Pastures areas, additional measures to address that threat will be selected and implemented instead, in consultation between KWP II, DLNR, and USFWS.

If monitoring after the first five years indicates that additional mitigation is required for mitigation efforts to be commensurate with the Baseline level of requested take or to provide a net benefit to the species, mitigation efforts will continue. Predator trapping will be continued if it is shown to be effective, other measures that may be implemented include, habitat improvement measures will be implemented, such as providing additional water sources at appropriate locations, or mowing grasses in habitat beyond the vicinity of KWP and KWP II to improve foraging habitat as described by Woog and Black (2001). The most appropriate measure to be undertaken will be determined based on data collected from the on-going monitoring and best available science and implemented in consultation with DLNR and USFWS.

In order for mitigation to be carried out on-site on State land, KWP II and DLNR anticipate that a Safe Harbor Agreement (SHA) will be executed to formalize compliance expectations related to the HCP and ITP terms and conditions. The Safe Harbor Agreement would meet the criteria set forth in 50 CFR Section 17, including: (1) implementation of the terms of the Safe Harbor Agreement would be reasonably expected to provide a net conservation benefit to the affected listed species by contributing to the recovery of listed species included in the ITP; (2) the probable direct and indirect effects of any authorized take would not appreciably reduce the likelihood of survival and recovery in the wild of an listed species; (3) implementation of the terms of the Safe Harbor Agreement would be consistent with applicable laws and regulations; (4) implementation of the terms of the Safe Harbor Agreement would not be in conflict with any ongoing conservation or recovery program for listed species covered by the ITP; and (5) KWP II LLC has shown capability for and commitment to implementing all of the terms of the ITP and Safe Harbor Agreement.

6.4.2.3 Additional Baseline Mitigation Measures Regardless of Alternative Chosen

In addition to the above, as part of mitigation for Baseline levels of take, a wildlife biologist will make systematic visual observations of nēnē activity from representative locations within the KWP II project area during the first year of project operation. The objective of these observations will be to document how nēnē use the project area following construction and to record observations of nēnē behavior and activity in the vicinity of the WTGs, including in-flight response to collision hazards (e.g. changing flight direction to avoid WTGs).

Observations will be made from at least three locations (upper, middle and lower points within the project area), and will occur on a weekly basis for at least three hours (one hour at each site). The time spent surveying from a particular location may exceed one hour if lengthening observation time provides more information useful in characterizing use patterns. The timing of

observation periods will vary to cover daylight and crepuscular periods. Night-vision or thermal imaging equipment (as available) may be used during low-light periods.

- Incidental observations of nēnē activity and response to the turbines will also be recorded under the WEOP (Appendix 4). Observations made as part of the WEOP will continue over the life of the project. These observations will contribute to a better understanding of how nēnē respond to wind facilities and will inform interpretations and management actions relevant to the population ecology of nēnē in West Maui. It is anticipated that avoidance and minimization measures will be refined and improved as a result of these studies, thereby reducing future nēnē fatalities at wind facilities.

6.4.3 Mitigation for Higher Rates of Take

Two possible alternatives are proposed for mitigation if post-construction monitoring indicates that take of nēnē is occurring at the Higher rates (as defined in Section 5.2.4.4). The alternative chosen for implementation will be decided in consultation with DLNR and USFWS and will be based upon the strategy that will most effectively meet mitigation requirements, best complement the recovery plans for the species, and is practicable.

6.4.3.1 Alternative 1

For the first alternative, the Applicant will provide funding for the release of additional goslings at a suitable off-site release pen identified at that point in time. Funding will be provided to DLNR to allow for the release of an additional 17 nēnē goslings (to compensate for an extra expected take of up to 5 female and 4 male adults) to be released in one year. The number of goslings released will meet the requested take at the Higher tier. These goslings will be released at the same pen as established for the Baseline mitigation measure. An additional 2 years of staffing for pen maintenance and predator control (\$20,000 per year) will also be provided.

However, should circumstances regarding nēnē population status or health change and indications are such that other conservation or management practices are deemed more important or pressing in aiding the recovery of the species, the Applicant in consultation with USFWS and DLNR will direct the funds toward whatever management or management activity is deemed most appropriate at the time.

6.4.3.2 Alternative 2

The lack of lowland habitat was identified as a threat to nēnē recovery and Hana'ula was identified as a key lowland site for re-establishment of nēnē populations (USFWS 2004). As such, one alternative proposes further habitat enhancement at Hana'ula and the Kaheawa Pastures area to improve nēnē survival and productivity in the area. Appropriate habitat improvement measures will be conducted, such as providing additional water sources at appropriate locations, or mowing grasses in habitat beyond the vicinity of KWP to provide improved foraging habitat (Woog and Black 2001) or the replanting of native food plants within alien dominated habitats to provide additional food sources. These efforts will be beyond what mitigation may already be provided at Baseline levels. The most appropriate measure to be undertaken will be determined based on best available data for the species, as well as data collected from the on-going monitoring on-site, and will be selected in consultation with DLNR and USFWS.

If monitoring of nēnē populations at Hana'ula and Kaheawa Pastures is no longer being funded by the Applicant at the time the Higher take scenarios occur, funding (\$15,000) will be provided to support the on-going monitoring until such time mitigation compensates for requested take at the Higher tier. On-going monitoring will provide information on whether the mitigation measures undertaken are increasing adult or juvenile survival or productivity and will also document the effects of Higher take levels on the overall population status in the area.

6.4.4 Mitigation for Lower Rates of Take

The Applicant will provide the first five years of Baseline mitigation regardless of whether a Lower rate of take is identified during the first five years of project operation. A Lower rate of take will be assessed for KWPII if the total adjusted take for a consecutive 5-year period is less than or equal to the KWPII 5-year requested take for the Lower tier. If mitigation efforts at that point in time have met the Baseline requested take, mitigation obligations will have been met and may cease with the concurrence of DLNR and USFWS. If take returns to Baseline or Higher levels, mitigation may resume if required by DLNR and USFWS.

6.4.5 Additional Measures for the Protection of Nēnē

The Applicant will fund the construction and operation of an additional nēnē release facility at a cost not to exceed \$60,000 and at a location to be determined by DLNR, and provide funding for a truck (up to \$10,000), up to three years of staffing (\$20,000 per year), helicopter gosling release (\$2,000 per year), and the purchase and release of goslings (number yet to be determined) for up to three years if either of the following occurs:

- The reintroduction effort of nēnē at the chosen release site is deemed to be failing as agreed by DLNR, USFWS, and the Applicant. This determination will be made if monitoring at the release facility indicates that the present population is unstable or decreasing when measured over any five-year period during the 20-year life of the KWP II project. If the failure of the release site occurs during the life of the KWP project, and impacts the mitigation obligations of KWP as well, the cost of construction and operation of the additional release pen will be shared between KWPII and KWP.
- The nēnē population at Hana'ula (associated with the release facility located above the KWP II project area), which is currently on the increase and believed to be self-sustaining, shows a decline over any five-year period for reasons directly attributable to take resulting from operation of the KWP II project. KWPII will shoulder the entire cost of construction and operation of the new release pen if the decline is attributable to KWPII only, however, if the decline is caused by the cumulative take at KWP and KWPII, the cost of construction and operation of the additional release pen will be shared between KWPII and KWP.

The Applicant recognizes the need to exercise flexibility and collaboration with DLNR and USFWS to provide successful mitigation for nēnē and acknowledge that there may be the need to implement adaptive management measures at any time during the life of the project. If for any reason mitigation efforts are unable to satisfactorily meet the necessary capacity under either Baseline or Higher take levels, as described, the Applicant is interested in supporting the development of the necessary framework for expanding mitigation to include intra- and inter-island translocation of nēnē in order to satisfy its obligations under the terms of the HCP and ITP/ITL and to provide a mechanism for broadening recovery options for the species.

6.4.6 Measures of Success

Strictly speaking, mitigation will be deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. In practice however mitigation measures are likely to provide much greater net benefits.

For the mitigation alternative where goslings are released at a release facility, all adults taken will be replaced by goslings. The mitigation will be deemed successful if the number of goslings that fledge at the pen due to releases or increases in reproductive success due to management exceed the requested number at the required tier of take (see Table 6.7).

If mitigation is conducted on-site at Hana'ula, and the Kaheawa Pastures area, this success may be measured by an increase in adult or juvenile survival or increased productivity (average number of fledglings per pair) at Hana'ula and the Kaheawa Pastures area over baseline levels. In this case, a taken adult may be replaced through increased survival rates of adults in the area or adults may be replaced by goslings. The number of fledglings produced will be the result of the

difference in productivity before (baseline) and after the implementation of predator trapping area multiplied by the number of nesting pairs estimated to be within the mitigation area. The number of adults saved from predation will consist of the difference in adult survival rates before (baseline) and after the implementation of predator trapping, multiplied by the estimated number of adults within the mitigation area. If the mitigation is conducted within a shorter time frame than the project lifetime, models will be used to demonstrate that the mitigation provided will result in a net benefit for the species at the appropriate tier for the entire permit term. The model will be chosen with the concurrence of KWP II, USFWS and DLNR.

If mitigation efforts at Hana'ula do not exceed the baseline productivity or adult survival rates for two years running (to take into account possible annual variations), then adaptive management measures will be implemented. The magnitude and scope of these measures will be determined by the Applicant in consultation with USFWS and DLNR and will be based upon monitoring data recorded from Hana'ula, KWP, and KWP II and best available science at that point in time.

Net benefit will also have been provided to the species for either mitigation measure chosen as both these mitigation measures will aid in establishing one or more self-sustaining populations on Maui, in accordance with the recovery plan for the nēnē (USFWS 2004).

To further ensure the success of the mitigation effort, the Applicant will establish a \$100,000 Nēnē Contingency Fund prior to construction of the proposed WTGs. The value of the fund will be adjusted at 2.5% over the life of the project. This would result in a total maximum of \$163,862 (if left unused through Year 20) over the 20-year term of the ITP. The fund will be available to implement adaptive management strategies to ensure mitigation is commensurate with the requested take of the required tier. If at the end of the 20-year period the mitigation implemented is not commensurate with the requested take of the required tier, any remaining funds will be used to continue to implement mitigation measures.

In addition, past, current or future funds allocated to other Covered Species may be expended where necessary to provide for the cost of implementing HCP mitigation measures for a particular species as long as the overall expenditure for mitigation at the Baseline tier (excluding contingency funds) does not exceed a total of \$2.489M. While KWPII will not be required to expend more than \$2.489M (excluding contingency funds) to fulfill its mitigation obligations at the Baseline tier for the Covered Species, funding for any individual Covered Species is not limited to those amounts estimated in Appendix 6. KWPII also recognizes the cost of implementing mitigation measures in any one year may exceed that year's total budget allocation, even if the overall expenditure for mitigation stays within the total amount budgeted over the life of the project. Accomplishing these measures may therefore require funds from future years to be expended, or likewise unspent funds from previous years to be carried forward for later use. Reallocation of funds among years may require up to 18 months lead time in order to meet revenue and budgeting forecast requirements.

6.5 HAWAIIAN HOARY BAT

Because of the lack of life history information on the Hawaiian hoary bat, research is identified as one of the key components in the recovery of this subspecies. The Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998) states that "Research is the key to reaching the ultimate goal of delisting the Hawaiian hoary bat because currently available information is so limited that even the most basic management actions cannot be undertaken with the certainty that such actions will benefit the subspecies."

Recent research by Gorresen et al. (2008) on Hawaiian hoary bat detectability and occupancy has identified several key areas of research required to improve life history knowledge. The areas identified are:

- Determining bat occupancy in different habitats
- Determining bat distribution across seasons on a local and regional scale
- Determining seasonal and daily peak bat activity periods
- Monitoring of population trends

Development and implementation of a survey and monitoring program remains a high priority and a key recovery objective for the Hawaiian hoary bat (Gorresen et al 2008, USFWS 1998).

Mitigation targets have been identified based on the levels of take identified as "Baseline" or "Higher." On-site monitoring during operations will be used to determine the tier at which Hawaiian hoary bat take is occurring. Mitigation is intended to compensate for take at Baseline level as described in Section 6.5.1. If monitoring shows that take is actually occurring below or in excess of Baseline level, adjustment to mitigation efforts would be made as described below (Section 6.5.2 and 6.5.3). The estimated cost for each proposed measure is presented in Appendix 6.

6.5.1 Baseline Mitigation

Mitigation for the Hawaiian hoary bat by KWPII was developed through discussions with USFWS, DLNR, and bat experts at USGS, and involved identifying the most immediate needs required for the recovery of the species. Based on the feedback received, the Applicant proposes a combination of,

1. on-site surveys to add to the knowledge base of the species' status on West Maui;
2. on-site research into bat interactions with the wind facility;
3. implementation of bat habitat improvement measures to benefit bats as determined in consultation with DLNR, USFWS and ESRC.

6.5.1.1 Bat Habitat Utilization at KWPII and Vicinity

The Applicant will continue to survey for and monitor Hawaiian hoary bats within and in the vicinity of the KWPII site. Surveys will be conducted during years when systematic fatality monitoring is conducted, (i.e., during the first two years and at five year intervals thereafter, or as otherwise determined under the Adaptive Management provisions), to allow observed activity levels to be correlated with any take that is observed. A critical component identified as essential to Hawaiian hoary bat recovery is the need to develop a standardized survey protocol for the Hawaiian hoary bat monitoring program to enable results collected by different parties to be directly comparable. The Applicant will also join the Hawai'i Bat Research Cooperative (HBRC) and as a contribution to the on-going research efforts in the state, will conduct its own surveys and monitoring at KWP II and the vicinity. Survey protocols will be developed in consultation with HBRC, following approval by USFWS and DLNR. Up to twelve anabat detectors will be deployed at KWP II and the vicinity.

The goal of this research will be to document bat occurrence, habitat use and habitat preferences on site, as well as identify any seasonal and temporal changes in Hawaiian hoary bat abundance. This research will be an extension of a 5-year survey already underway on the island of Hawai'i and another that will shortly commence on Maui.

6.5.1.2 Research on Bat Interactions with the Wind Facility

In conjunction with the two year study to determine habitat utilization by bats at KWPII and its vicinity, KWPII proposes to conduct additional on-site surveys that will contribute to identifying areas of potential interactions and vulnerabilities of Hawaiian hoary bats at wind facilities, as follows:

1. KWPII will survey for bat activity near turbine locations for the first two years of operation using acoustic bat detectors. Surveys will be conducted during years when systematic fatality monitoring is conducted (see Appendix 2 and Section 7.2.1). USGS (HBRC) monitoring protocols will be used and adjusted if necessary. Thermal imaging or night vision technology will be used to assist acoustic monitoring as trends are detected and would follow similar protocols developed during pre-construction monitoring. The use of additional techniques and technologies will also be considered. These data will be analyzed in an effort to determine seasonal and daily peak bat

activity periods on-site, and comparison of data with pre-construction activity levels will help determine if bats are being attracted to the wind facility.

2. Incidental bat observations will be recorded under the WEOP (Section 6.1 and Appendix 4).

These on-site surveys are expected to advance avoidance and minimization strategies that wind facilities in Hawai'i and elsewhere can employ in the future to reduce bat fatalities.

6.5.1.3 Implementation of Management Measures

The Applicant will contribute an additional negotiated amount of \$25,000 up to a maximum of \$150,000 to fund an appropriate management program. As recommended by DLNR, USFWS and ESRC that the measures if implemented as stipulated will be sufficient to mitigate for the Baseline requested take and provide a net benefit to the species.

DLNR, USFWS, ESRC and the Applicant will consult to determine the most appropriate measures for implementation. Because the measures have not yet been determined, a budget range for implementing measures has been established based on preserving or enhancing foraging and/or roosting habitat capable of supporting a commensurate number of bats to achieve the mitigation requirement. The Baseline requested take of 12 adult bats and 9 juveniles (see section 5.2.5.3) equates to a total of 15 adults (with an estimated 30% survival rate of juveniles to adulthood, see Appendix 5 for life history information). The core area for an adult bat is estimated to be 13.3 ac (5.4 ha, see section 3.4.8.1), therefore, a total area of approximately 200 ac (82.5 ha) may be required for 15 adults, assuming no spatial overlap and no empty territories. One preliminary option to improve bat habitat was developed during discussion with DLNR and is listed below.

Native habitat plant restoration at a previously burned forest on Maui was identified as one option for enhancing bat habitat. The Polipoli area of the Kula Forest Reserve in East Maui was burned by a wildfire in 2007. A total of approximately 2,300 acres of forested public lands, including the Polipoli area, within Kula Forest Reserve was burned at this time. This burn unit was dominated by mature closed canopy forest comprised primarily of pines, cypresses, and redwoods. One of the goals in the restoration of this burned unit was to enhance native species habitat and native ecosystem recovery (DLNR 2007b). This unit was known to support a variety of native birds and the Hawaiian hoary bat before the wildfire (Duvall pers. comm.). The initial outplanting has been completed and 50, 30 and 20 percent of the 1,800 acre reforestation areas were planted with native trees (a koa – ohia mixture), redwoods, and grass/shrublands, respectively. DLNR has identified a need for funding for native habitat plant restoration which consists of supplemental planting to replace seedling mortality, implementation of rodent control, weed control and fertilization programs to enhance tree seedling survival and forest establishment. KWPII will support native habitat plant restoration for the entire 1,800 ac reforestation area, estimated to cost \$125,000 in 2010 or \$100,000 for the year 2011. Alternatively, funding may be used to conduct native habitat plant restoration at the Polipoli area for two years. The funding will be provided to support native plant habitat restoration which will be conducted by a qualified contractor or personnel approved by DLNR or USFWS.

It is anticipated that the measure outlined above or any others that are developed in the future will be conducted in partnership with other conservation groups or entities and that these activities will complement other restoration, reforestation or conservations goals occurring in that area at the time. Other sites may be chosen if they are determined to be more appropriate for the implementation of the mitigation measures. The allocation of the funds for any mitigation measure would be determined by the Applicant in consultation with USFWS and DLNR. Funds will be directed toward whatever management or research activity is deemed most appropriate at the time.

6.5.2 Mitigation for Higher Rates of Take

6.5.2.1. Low Wind-Speed Curtailment

Should KWPII exceed the 5-year or 20-year Baseline rate of take, KWPII will immediately implement low wind-speed curtailment by increasing the cut-in speed of all turbines (or a subset of turbines if so determined by DLNR and USFWS) from their normal operation to 5m/s during periods when bats are active, approximately from dusk till sunrise, during times of the year when fatalities are occurring. Low wind speed curtailment will be implemented unless there is strong evidence that the observed fatalities are a result of some other cause that can be corrected by other means. The final determination of whether to implement low wind speed curtailment will be made by DLNR and USFWS, in consultation with KWPII.

Recent studies on the mainland indicate that most bat fatalities occur at relatively low wind speeds, and consequently the risk of fatalities may be significantly reduced by curtailing operations on nights when winds are light and variable. Research is suggesting this may best be accomplished by increasing the cut-in speed of wind turbines from their normal levels (usually 3.5 or 4 m/s, depending on the model). Research conducted by Arnett et al. (2009) found that bat fatalities could be reduced by 53-87 percent when cut-in speed was increased to 5 m/s. No significant additional improvement over this level was detected when the cut-in speed was increased to 6.5 m/s. Because power increases exponentially with wind speed, at low wind speeds the power loss is generally modest, however, incrementally increasing the cut-in speed above 5 m/s results in an exponential increase in lost power. These findings are encouraging and hold promise for reducing fatalities at projects where bat fatalities have been found to be high.

The times of the year when curtailment is implemented (i.e., year-round or seasonal) at KWPII will be decided based on bat detection data on site, seasonal distributions of observed fatalities on site, and best available science, with concurrence from USFWS and DLNR.

In addition to the immediate implementation of low-wind speed curtailment, KWPII will review the fatality records in an effort to determine whether additional measures can be implemented that will reduce or minimize take. If causes cannot be readily identified KWPII will conduct supplemental investigations that may include but not be limited to:

1. additional analysis of fatality and operational data;
2. deployment of acoustic bat detectors to identify areas of higher bat activity during periods when collisions are believed to be occurring;
3. using thermal imaging or night vision equipment to document bat behavior;
4. determining whether certain turbines are causing most of the fatalities or if fatality rates are related to specific conditions (e.g., wind speed, other weather conditions, season)

Other measures to reduce bat fatalities will be implemented as identified and feasible and may include changes in project operations such as modifying structures and lighting, and implementing measures to repel or divert bats from areas of high risk without causing harm if practicable. These data may also be used to refine low-wind speed curtailment options, such as determining the times of year when curtailment is mandatory, or if curtailment can be confined to a subset of "problem" turbines. These additional measures will be implemented by KWPII with the concurrence of USFWS and DLNR.

6.5.2.2. Implementing Bat Habitat Management Measures

An additional negotiated amount of \$15,000 up to a maximum of \$75,000 will also be provided to implement appropriate Hawaiian hoary bat management measures when identified. This budget range has been determined based on an expenditure of up to 50% above the maximum Baseline budget, which is reasonable considering that provisions for low-wind speed curtailment could be triggered before the 20-year Baseline take levels are reached. This funding will be used to conduct mitigation measures that will be deemed to be appropriate to compensate for the

requested take at the Higher tier. The most appropriate mitigation measure to be implemented will be determined in consultation with DLNR and USFWS.

6.5.3 Mitigation for Lower Rates of Take

As the proposed Baseline mitigation will be carried out within the first two years of project operation, no change to mitigation measures will occur should a Lower rate of take be determined.

6.5.4 Measures of Success

The success of the mitigation efforts will be determined as follows:

1. Both components of on-site research into Hawaiian hoary bat habitat utilization and bat interaction with wind facilities will be considered successful if KWPII joins the HBRC and the specified survey and monitoring is carried out, including proper deployment and operation of bat detectors, data reduction and analysis, and reporting of findings to DLNR, USFWS and ESRC;
2. In the event that KWPII exceeds the Baseline rate of take measures to reduce bat fatalities will be considered successful if one or more causes can be identified and corrective measures are implemented that result in an estimated 50 percent or greater reduction in bat fatalities over previous levels when averaged over a five-year period.
3. Implementation of management measures will be considered successful if KWPII contributes \$25,000 to \$150,000 (for take at or below Baseline) within 6-months of beginning project operations, plus an additional \$15,000 to \$75,000 (for Higher Take upon exceeding the 20-year Baseline requested take) within 6-months of the determination, to fund management that is commensurate with the requested take at the required tier, and the management is carried out and is agreed upon by USFWS and DLNR to provide a net benefit to the species.

To ensure the success of the mitigation effort, KWPII will establish a \$75,000 Hawaiian Hoary Bat Contingency Fund. The fund will be compounded at 2.5% annually over the entire 20-year term of the HCP resulting in a total possible maximum of \$122,896 (if left unused at year 20). If the fund is drawn upon at any time, the interest will continue to accrue for the remaining balance. This fund will be available to implement adaptive measures to ensure that mitigation is commensurate with the requested take of the required tier. The fund will also be used to implement measures to reduce the likelihood of collisions on site or the protection of roost sites as identified by USFWS and DOWAW. If at the end of the 20-year period the mitigation is still not commensurate with actual take, any remaining contingency funds will be used for further mitigation efforts.

In addition, past, current or future funds allocated to other Covered Species may be expended where necessary to provide for the cost of implementing HCP mitigation measures for a particular species as long as the overall expenditure for mitigation at the Baseline tier (excluding contingency funds) does not exceed a total of \$2.489M. While KWPII will not be required to expend more than \$2.489M (excluding contingency funds) to fulfill its mitigation obligations at the Baseline tier for the Covered Species, funding for any individual Covered Species is not limited to those amounts estimated in Appendix 6. KWPII also recognizes the cost of implementing mitigation measures in any one year may exceed that year's total budget allocation, even if the overall expenditure for mitigation stays within the total amount budgeted over the life of the project. Accomplishing these measures may therefore require funds from future years to be expended, or likewise unspent funds from previous years to be carried forward for later use. Reallocation of funds among years may require up to 18 months lead time in order to meet revenue and budgeting forecast requirements.

6.6 MITIGATION FOR OTHER NATIVE SPECIES – THE HAWAIIAN SHORT-EARED OWL

Since the start of project operations at KWP four years ago, one observed take of the Hawaiian short-eared owl attributable to collision with a turbine has been documented. Hawaiian short-eared owls also occur at the KWPII area (see section 3.7). Hence, it is reasonable to expect that a

low level of take may also occur at KWPII over the life of the project. While this native species is common on Maui, KWPII intends to offer mitigation to compensate for the impacts that the wind facility may have on the species in the vicinity.

Mitigation for possible take of the Hawaiian short-eared owl by KWPII will consist of two parts: funding research and rehabilitation of injured owls. Therefore, upon issuance of the incidental take permit, KWPII will contribute a total of \$25,000 to appropriate programs to support owl research and rehabilitation.

As little is known about the life history of the Hawaiian short-eared owl, research could be designed to develop protocols to monitor Hawaiian short-eared owl populations, determine habitat use and preferences and evaluate the effectiveness of habitat management techniques. Concurrently, funding will also be used to develop a rehabilitation program for Hawaiian short-eared owls that are found injured (such due to vehicular collisions) and brought in by the public or agencies.

The allocation of funds to research and rehabilitation will be determined by DLNR and USFWS. The research funding may be used for (but not limited to) the purchase of radio transmitters, receivers, or provide support for personnel to conduct research such as a population census. However, these funds will be used for whatever management or research activity is deemed most appropriate at the time, with the concurrence of USFWS and DLNR.

The rehabilitation program could consist of training selected veterinarians in the assessment and appropriate care of injured Hawaiian short-eared owls. This would in turn enable the veterinarians to obtain the necessary permits required to handle the birds. Other possible funding applications could be a public outreach program where the public would be informed of the appropriate steps to take upon encountering an injured Hawaiian short-eared owl. The allocation of funds for owl rehabilitation will be determined by DLNR and USFWS and will be used for whatever rehabilitation activity is deemed most appropriate at the time.

It is anticipated that the research conducted will result in an increased understanding of the habitat requirements and life history characteristics of Hawaiian short-eared owl populations, leading to the development practicable management strategies and possibly help with the recovery of the Hawaiian short-eared owl on O'ahu. The rehabilitation efforts of injured owls are anticipated to offset any impact that the wind facility may have on the local population in the area.

6.7. RESTORATION OF VEGETATION AND PREVENTION OF SOIL EROSION

KWP II is in the process of undergoing review of their CDDA (appendix 1) with the Office of Conservation and Coastal Lands (OCCL). As part of that process, a plan for revegetating disturbed areas and reintroducing native plants is being proposed. The proposed revegetation strategy is included here for reference. KWP II plans to implement a revegetation strategy to restore vegetation in temporarily disturbed areas intended to meet the dual objectives of stabilizing disturbed areas immediately following construction, and a longer-term effort to re-introduce and establish several native plant species throughout the site. Most elements of this plan are derived from experiences and lessons learned at the adjacent KWP project site, which underwent construction in early 2006, and which has a comparable plant ecological history. KWP II anticipates working alongside and in collaboration with DLNR Forestry and Wildlife specialists to ensure that revegetation initiatives consider and incorporate all wildlife, forestry, fire and rangeland concerns and are in alignment with the management provisions of the Conservation District. The goal is to immediately stabilize soil and prevent erosion following construction. Details of the revegetation plan are included in Appendix 8.

6.7.1. Immediate Revegetation to Control Soil Erosion

Due to the rocky nature of much of the KWP II area, revegetation is anticipated in only limited areas. Much of the area modified for the project will result in coarse rocky surfaces, and thus will remain unvegetated, including the turbine pads (kept open for increased searcher efficiency), cuts into native rock, and riprap slopes. Revegetation will be implemented for erosion control in areas

where finished grading results in exposed soil, such as along the edges of some turbine pads and along certain road cuts and fill slopes. In such areas KWP II proposes to apply a hydro-seed mixture of annual rye (*Lolium multiflorum*) to establish an initial cover of vegetation. Annual rye grass is expected to provide rapid cover that will gradually die back and allow natural recruitment of neighboring species. Supplemental irrigation for a 90-day period and monitoring will be necessary to ensure that immediate revegetation measures are successful. This phase of the project will be considered successful if it can be demonstrated that >75% of the bare areas, fill slopes, and road cut segments that receive treatment have established cover within one year following treatment. If initial applications appear to be only partially successful, subsequent hand and/or hydro-seeding applications or additional temporary measures (e.g., excelsior, jute or coir matting) may be installed to ensure adequate coverage and erosion control. Over time, areas revegetated with Annual rye will be supplemented with suitable hardy native seedlings, or other appropriate non-invasive plants in accordance with the revegetation plan (Appendix 8).

6.8 MANAGING INVASIVE SPECIES

KWP is also working actively to minimize and reduce the ingress of certain undesirable invasive plant species. For example, fireweed (*Senecio madagascariensis*) is a pasture weed that is highly toxic to grazing livestock and is known to readily exploit disturbed areas. KWP II intends to continue measures to minimize and avoid the introduction of invasive species to the Kaheawa Pastures area during the proposed wind farm development using best management practices (Appendix 1). These measures include the cleaning and inspection of all equipment, materials, and vehicles brought onto the site during construction to prevent the introduction of invasive or harmful non-native species. KWP II will ensure that construction materials brought from off-site will be inspected and documented along with recommendations for managing materials prior to transport and use. An inspection station at the staging area near the main highway will be established to reduce the possibility of introducing alien plant species to the site prior to project work. Each vehicle will be inspected and cleaned of debris or plant materials prior to authorizing traveling up to the site. KWP II LLC will support and collaborate with the FireWeed Group on existing efforts to control and manage fireweed. KWP II LLC will consult with the Hawai'i Department of Agriculture and Maui Invasive Species Commission to establish protocols and training orientation methods for preventing invasive species introductions. Post-construction protocols will also be developed to minimize the spread of existing invasive species and monitor the potential establishment of new introduced species.

7.0 IMPLEMENTATION

7.1 HCP ADMINISTRATION

The Applicant will administer this HCP under the direction of the USFWS and DLNR. In addition, outside experts may be periodically consulted, including biologists from other agencies (e.g., National Park Service, USGS), private conservation organizations, conservation partnerships (e.g., Nēnē Recovery Action Group), consultants, and academia. When appropriate, and as requested by USFWS and DLNR, HCP-related issues may be brought before the ESRC for formal consideration.

The Applicant will meet at least semi-annually with USFWS and DLNR. Additional meetings/conferences may be called by any of the parties at any time to address immediate concerns. The purpose of the regular meetings will be to evaluate the efficacy of monitoring methods, compare the results of monitoring to the estimated take, evaluate the success of mitigation, and develop recommendations for future monitoring and mitigation. Regular meetings will also provide opportunities to consider the need for adaptive management measures, or changes to the monitoring protocol or mitigation measures. In addition, the Applicant will meet annually with the ESRC to provide updates of monitoring, mitigation, and adaptive management, and to solicit input and recommendations for future efforts. Additional meetings may be requested by the ESRC at any time to address immediate questions or concerns.

7.2 MONITORING AND REPORTING

Monitoring and reporting by the Applicant will address both compliance and effectiveness. Compliance monitoring will verify the Applicant's implementation of the HCP terms and conditions. Annual reports and other deliverables as described below will be provided to USFWS and DLNR to allow them to independently verify that the Applicant has performed all of the required activities and tasks on schedule. Monitoring will investigate the impacts of the authorized take and the success of the HCP's mitigation program. The monitoring will involve surveys to make sure the authorized level of take is not exceeded, and that the effects of take are minimized and mitigated to the greatest extent practicable (i.e., minimization and mitigation measures are sufficient and successful).

7.2.1. Monitoring

The Applicant proposes to document bird and bat injuries and fatalities, including covered and non-Covered Species, following methods that have been used effectively at other wind energy generation facilities in Hawai'i and the continental United States. Details of the proposed monitoring protocol are provided in Appendix 2. Key components include:

- Use of KWP II technical staff and/or third-party contractors who have been trained by experienced biologists having specialized expertise in conducting wind turbine/bird interaction studies. Criteria for selecting 3rd party contractors approved by USFWS and DLNR will be developed in consultation with DLNR and USFWS. . Additional contingency funds are provided in the event a third party contractor is required for monitoring and will only be used for this purpose.
- Carcass removal (i.e., scavenging) and searcher efficiency (SEEF) trials will be conducted each season using carcasses of different size classes within different vegetation types. Two seasons will be addressed: the winter/spring season (December – May) and summer/fall (June – November). Three size classes have been chosen to represent the size classes of the Covered Species - bat sized, medium birds and large birds. The vegetation will be classified according to structure (bare ground and mowed grass) and the vegetation types and their boundaries will be mapped at KWP II after construction. Carcass removal and SEEF trials will be conducted with sufficient replication to produce statistically reliable results. These results will provide a basis for estimating unobserved take (see Appendix 2 on study design); The Applicant will all cover costs and responsibilities for acquiring carcasses for trials;

Intensive searches will be conducted for the first two years under the direction of a qualified biologist, after which it is expected that the approach will be reduced to a sampling method based on the results obtained up to that point. Systematic searches of 50% reduced effort will subsequently be conducted at 5-year intervals and a further reduced but regular sampling method conducted during the interim years;

- The frequency of searches during the intensive search years will ensure that a variety of conditions are included. For example, days after moonless, cloudy, or stormy nights are of particular interest, because the wind turbines would be least visible and the risk of collision would presumably be greater, especially during peak fledging periods;
- Incidental observations by on-site staff of bird use, injury, and mortality will be documented in accordance with the WEOP and Downed Wildlife Protocol described in Section 6.1 and 6.2.

7.2.2. Reporting

If the minimal search interval is exceeded, the Applicant will report the event to USFWS and DLNR within a week. If the minimal search interval is exceeded more than once per season (for reasons other than weather, health or safety), the Applicant, DLNR and USFWS will discuss possible adaptive management measures to address and correct the problem.

Semi-annual meetings with DLNR and USFWS will be held in March and September to provide brief progress reports and summarize the findings of scavenging, SEEF trials and results of mitigation efforts. Electronic copies of HCP related data will also be submitted with the progress reports. If necessary, take limits will be reviewed and changed circumstances or adaptive management measures will be discussed with DLNR and USFWS as needed. In addition, should a take of a Covered Species occur, DLNR and USFWS will be notified within 24 hours by phone and an incident report will be filed within 3 business days (Appendix 14).

Annual reports summarizing the results of each of the two years of intensive monitoring will be prepared and submitted to DLNR and USFWS. These reports will identify: 1) actual frequency of monitoring of individual search plots 2) results of SEEF and carcass removal trials with recommended statistical analyses if any, 3) directly observed and adjusted levels of take for each species; 4) whether there is a need to modify the mitigation for subsequent years; 5) efficacy of monitoring protocols and whether monitoring protocols need to be revised; 6) results of mitigation efforts conducted as part of the HCP; 7) recommended changes to mitigation efforts if any; 8) budget and implementation schedule for the upcoming year and 9) continued evidence of the Applicant's ability to fulfill funding obligations. The annual report will be submitted by August 1 each year along with electronic copies of HCP related data. The report will cover the period from June to July of the year before. Agencies will have 15 calendar days to respond to the report, after which a final report incorporating responses to the agencies will be submitted by September 1. The report may also be presented to ESRC as required.

In subsequent years, monitoring may consist of a reduced level of effort, consisting of smaller search plots at a subset of turbines, with plots being relocated periodically to sample a variety of locations. The ongoing effort will be supplemented by the WEOP Program, as implemented by on-site staff. Depending upon the findings, the location and focus of the ongoing effort can be modified, with the concurrence of the USFWS and DLNR, to target areas or times of particular interest. A table summarizing the results of incidental observations will be submitted to DLNR and USFWS twice each year. The first would be submitted in January (post-fledging for seabirds in the previous year) and the second in July (post-fledging for nēnē). In addition, in accordance with the Downed Wildlife Protocol, biologists at DLNR and USFWS will be notified whenever a Covered Species is found dead or injured. The Applicant will confer formally with the USFWS and DLNR at least once a year following submittal of the annual report to review each year's results, review the rates of take (directly observed and as adjusted), and plan appropriate future mitigation and monitoring measures. Any changes to future mitigation and monitoring would only be made with the concurrence of USFWS and DLNR.

7.3 SUMMARY OF ADAPTIVE MANAGEMENT PROGRAM

According to USFWS policy [see 65 Fed. Reg. 35242 (June 1, 2000)], adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resources management, using the experience of management and the results of research as an on-going feedback loop for continuous improvement. Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers is often unavailable. Adaptive management also includes, by definition, a commitment to change management practices when determined appropriate.

In the case of KWP II, some uncertainty exists in the proposed project, from estimated rates of take to the success of the proposed mitigation measures. Fortunately, because of the adjacent KWP project and the monitoring surveys that have been conducted since its turbines were erected in 2006, the level of uncertainty in the estimated rates of take is believed to be quite low.

Similarly, there is reasonable basis for expecting the proposed mitigation measures to be successful, including a track record for successfully improving breeding success of seabirds through predator control and social attraction at colonies in Hawai'i and elsewhere, and a long history of nēnē releases on Maui and other islands. Nonetheless, uncertainties remain and as a result, adaptive management provisions have been incorporated into this HCP.

The proposed tiered approach to mitigation was designed with adaptive management in mind as it is acknowledged that actual rates of take may not match those projected through the seabird modeling and results of mortality monitoring performed to date at the KWP facility. Mitigation efforts will increase if monitoring demonstrates that incidental take is, or may be, occurring above Baseline levels. Mitigation efforts would also be allowed to decrease in some instances if rates of take are believed to be occurring below Baseline levels. Any changes in the mitigation effort would be made only with the concurrence of USFWS and DLNR. Regardless of recorded take levels, the avoidance and minimization measures described in Section 4.3 would be employed for the duration of the KWP II project.

Monitoring of seabird and nēnē mitigation efforts is intended to inform the Applicant, USFWS, and DLNR as to whether these efforts are adequately compensating for the total direct take and indirect take assessed to the KWP II facility. If monitoring reveals that a particular mitigation effort is not achieving the necessary level of success as dictated by the amount of take assessed to the KWP II facility, the Applicant will, as adaptive management and through consultation with USFWS and DLNR, develop and implement a revised mitigation strategy intended to meet the project mitigation requirements. As long as take remains at or below Higher levels as identified in Section 5.0, any actions performed in response to this adaptive management process would be performed under the mitigation budget established for the project.

If the take of any of the Covered Species exceeds that authorized by the ITP and ITL at the Baseline level, but remains within the range identified in Section 5.0 as the Higher rate for that species, the Applicant will increase the mitigation effort for that species as prescribed in Section 6.0. As an adaptive management process, the Applicant will also promptly discuss this situation with USFWS and DLNR to review the total take of that species recorded to date at the KWP II facility and the mitigation performed to date on behalf of that species, and to identify whether mitigation performed to date has compensated for the Higher rate of take, or whether changes in mitigation are needed to compensate for the Higher rate of take. The Applicant may also consider whether changes in operational practices are needed to reduce levels of take. Any changes to the mitigation efforts would be made only with the concurrence of the Applicant, USFWS, and DLNR, and within the mitigation budget established for the project.

7.4 FUNDING

Sufficient funding will be made available to ensure that the proposed measures and actions in the HCP are undertaken in accordance with the schedule. An estimate of the costs of funding the proposed mitigation plan is presented in Appendix 6.

Funding for the implementation of the HCP will be provided by KWP II LLC as an annual operating expense paid *pari passu* with other operating expenditures (operation and maintenance costs, insurance, payroll, lease payments to the State of Hawai`i, audit costs, and agency fee costs) and most importantly, ahead of both debt service to lenders and dividends to equity investors.

Assurances that adequate funding will be available to support the proposed monitoring and mitigation measures will be provided by KWPII in the form of a bond, letter of credit or similar instrument naming the DLNR as beneficiary. The terms and conditions of such instrument(s) are the subject of ongoing discussions with the agencies and will be included in the final HCP and IA. As currently proposed, KWPII will provide a rolling letter of credit (LC) or bond in the amount of \$500,000, which will be available to fund mitigation in the unlikely event of a revenue shortfall or, in the worst case scenario, bankruptcy. The LC will be automatically renewed prior to expiration, unless it is determined to no longer be necessary by the USFWS and DLNR. In the event of a revenue shortfall or bankruptcy the LC could be drawn upon by the USFWS or DLNR to fund any outstanding mitigation obligations of the project.

The applicant will establish an additional, single bond or letter of credit for the value of the four contingency funds which start at \$335,000. The amount of the bond will increase at 2.5% annually over the term of the HCP. If contingency funds are used, the amount of the bond would be reduced accordingly, and the net amount would continue to increase at a 2.5% annual rate.

7.5 CHANGED CIRCUMSTANCES

The HCP process allows for acknowledgement of, and planning for, reasonably anticipated changes in circumstances affecting the subject species, other species occurring in the project area, or in efforts expended towards mitigation. Changed circumstances that can be anticipated are not unforeseen circumstances, as described below.

Changed circumstances that may affect the implementation of the HCP include, but are not limited to:

1) Global Climate Change Significantly and Negatively Alters Status of the Covered Species

Global climate change within the life of the project (20 years) has some limited potential to alter the current distribution of vegetation communities utilized by the Covered Species through region-wide changes in weather patterns, sea level, average temperature and levels of precipitation (IPCC 2007). In some instances, climate change may also cause populations of Covered Species to decline. Covered seabird species are likely to be affected through changes in the distribution of their food resources at sea and possible changes in the vegetation at their preferred nesting habitats. The distribution of nēnē native food resources, particularly at high elevations, may change if climate change alters the range of native plants that they utilize. Nēnē, however, are also able to use a wide variety of non-native food resources. Hawaiian hoary bat are not expected to be affected by any changes in climate over the life of the project due to their ability to utilize non-native habitats which are unlikely to decrease in availability during that time frame.

With climate change, hurricanes or storms may occur with greater intensity (Webster et al. 2005, US Climate Change Science Program 2009), which would increase the risk of damage to established mitigation sites. This is discussed in Scenario 8 below. Sea level is predicted to rise approximately 1 m in Hawai`i by the end of the 21st Century (Fletcher 2009). Given this, any rise in sea level experienced during the life of the project would likely be less than 1 m. As all the mitigation sites for the Covered Species are at or more than 1 m above sea level, these sites are unlikely to be impacted by sea level rise while the project is operational.

Precipitation may decline by 5 -10 % in the wet season and increase 5 % in the dry season, due to climate change (Giambelluca et al. 2009). Vegetation at the seabird or nēnē mitigation sites may change with decreased precipitation or increased temperatures, however, changes are expected to be small over the lifetime of the project. Should

significant changes in vegetation be deemed to be occurring and demonstrated to affect the productivity of the Covered seabird species or nēnē, other mitigation sites will be considered for continued mitigation if deemed necessary and will be chosen in consultation with USFWS and DLNR. In all cases, mitigation efforts will remain commensurate with requested take (unless agreed by all parties otherwise) with a net benefit provided to each Covered Species as required by State law.

Any changes in the mitigation measures implemented for any of the Covered Species due to climate change will be performed under the budget established for mitigation expenses in this HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

2) Listing of a new species.

In the event that one or more species that occur on-site are listed pursuant to the ESA, the Applicant will evaluate the degree to which the species is (or are) at risk of being incidentally taken by project operations. If take of the species appears possible, the Applicant will then assess whether the mitigation measures already being implemented provide conservation benefits to the newly listed species and if any additional measures are needed to provide a net conservation benefit to the species. The Applicant would then seek coverage for the newly listed species under an amendment to the HCP if it is determined that the coverage would benefit both Kaheawa Wind Power II and the species.

3) Deleterious change in relative abundance of non-native plant species or ungulates occurring at the mitigation sites for Covered Species.

Should the proportion or coverage of non-native plant species or ungulates increase at any mitigation site to a point where it is believed that this change is causing significant habitat degradation or loss of habitat for any of the Covered Species, thereby resulting in a measurable decline of the species at the site, the Applicant will consult with DLNR and USFWS to determine if measures to prevent the further spread of non-native plants or incursion of ungulates are available, practical, and necessary. If no such measures are available, mitigation measures for the affected Covered Species may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

4) Uluhe dieback at the seabird mitigation site

Observations of uluhe dieback were recorded in Hawaii after the accidental introduction and spread of the two-spotted leafhopper (*Sophonia rufofascia*). Several studies implicate *Sophonia rufofascia* as the cause of uluhe dieback, however, there are indications that other factors (as yet unknown) are also required for dieback to occur (Follett et al. 2003). Should uluhe dieback occur at the seabird mitigation site, and then increase to the point where the dieback causes significant loss of habitat for seabirds, thereby resulting in a measurable decline of the species at the site, the Applicant will consult with DLNR and USFWS to determine if measures to prevent the further spread of the dieback are available, practical, and necessary. If measures to prevent further spread of the dieback are not available, the Applicant will explore other measures available to re-create nesting habitat such as the use of artificial burrows. The use of another seabird colony for the implementation of mitigation efforts may also be explored. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required,

contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

5) Increased abundance of predators at the seabird mitigation site

If an increase in predator occurrence is observed or becomes unmanageable during the implementation of mitigation for seabirds at Makamaka'ole and/or any other seabird study areas, or if such changes affect monitoring or the success of mitigation, then the Applicant will consult with DLNR and USFWS to determine if measures to prevent further ingress of predators are necessary. Such measures may include more aggressive removal of predators and/or modification of mitigation actions. If no such measures are available, mitigation measures for seabirds may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

6) The outbreak of disease affecting the Covered Species.

Disease is considered one of the lesser threats to the persistence of the seabirds, nēnē, and bat covered in the HCP. Newell's shearwater and Hawaiian petrel have not been documented to have disease outbreaks, although Newell's shearwater fledglings have been found with mild symptoms of avian pox (Ainley and Reynolds 1997, Mitchell et al. 2005, Simons and Hodges 1998). Nēnē are not considered to be limited by disease, although omphalitis, an infection of the umbilical stump, has been found to cause mortality in both wild and captive nēnē goslings (USFWS 2004). These geese have also been documented to have been infected with avian pox and avian malaria but no deaths have been attributed to either disease (USFWS 2004). It is considered possible that the introduction of West Nile virus may affect the survival of nēnē (USFWS 2004). It is currently not known if the Hawaiian hoary bat is susceptible to any diseases. Should the prevalence of disease increase dramatically and become identified as a major threat to the survival of any of the Covered Species by DLNR and USFWS, the Applicant will consult with DLNR and USFWS to determine if changes in monitoring, reporting, or mitigation are necessary to provide assistance in documenting or reducing the impact of the disease. If no such measures are available, mitigation measures for the affected Covered Species may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

7) Changes in the price of raw materials and labor.

Annual reviews will be performed to analyze the costs in the previous year's budget for mitigation expenses and cumulative costs. Annual expenses for subsequent years will be adjusted to meet projected costs based on previous years' expenditures, and cumulative spent to date.

8) Natural disasters such as hurricanes, storms, or fire, of sufficient magnitude to significantly affect the Project site or mitigation sites for any of the Covered Species.

Natural disasters, including wildfires regardless of origin, have potential to significantly affect the status of one or more of the Covered Species on Maui and, consequently, alter the relative importance of the incidental take of individuals. Such disasters could also greatly hinder or disrupt mitigation efforts.

Seabirds such as Newell's shearwater have been shown to vacate nesting areas in response to approaching intense low-pressure areas. Thus, adults are unlikely to suffer significant mortality from hurricanes or other storm events. If a hurricane were to occur during the seabird nesting period (as did Hurricane 'Iniki in 1992), it might destroy eggs or chicks by uprooting of trees or by creating mudslides at the mitigation site. If necessary, the Applicant in consultation with DLNR and USFWS, will contribute to measures to rehabilitate seabird nesting habitat within seabird mitigation sites that are damaged during hurricanes or major storms as allowed by the mitigation budget established under the HCP. Possible contributions could include removing of debris, contribution to revegetation efforts or rehabilitation of injured Covered Species as deemed necessary. If the habitat destruction due to the hurricane or storm is so extensive as to render the mitigation site unsalvageable or is altered such that it is no longer utilized by nesting seabirds, any remaining mitigation will be carried out at another seabird nesting site, chosen in consultation with USFWS and DLNR. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

It is not known how nēnē or Hawaiian hoary bats respond to storms or hurricanes. Because these species are comparatively sedentary compared to the seabirds, it is presumed likely that individuals of these species would seek available shelter rather than flee when confronted by major storms. The Applicant may implement changes in monitoring, reporting, or mitigation to help population recovery or contribute to rehabilitation of habitat for nēnē and/or Hawaiian hoary bat following a major storm, if deemed appropriate by DLNR and USFWS. If no such measures are available, mitigation measures for these Covered Species may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

Wildfires have occurred at the Project Site with some regularity, with the most recent fire at Kaheawa Pastures occurring in 2006 (Hobdy 2006, 2009). Fire could cause significant loss of foraging and roosting habitat for the population of nēnē currently established in the area. In the event of fire causing significant habitat degradation and loss of habitat for the nēnē, thereby resulting in a measurable decline of the species at the site, the Applicant may, in consultation with DLNR and USFWS contribute habitat restoration measures which may consist of replanting or management of vegetation important for the persistence of the nēnē population and/or measures to prevent the spread of invasive plant species. Such measures and consequent changes in monitoring, reporting or mitigation deemed appropriate by DLNR and USFWS will be implemented if necessary. If no such measures are available, mitigation measures for the nēnē may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required, contingency funds and the Surety Letter or Credit if mitigation actions have not been fully achieved or unmitigated take remains.

The Applicant will report such changes as they occur and DLNR and USFWS would work with the Applicant as soon as possible to discuss any necessary changes in the implementation of the HCP. The Applicant will implement necessary changes as soon as possible and will assist DLNR and USFWS in any related response or remediation efforts. Such changes are, therefore, provided for in this HCP and do not constitute unforeseen circumstances or require the amending of the ITP or ITL.

The Applicant will implement additional conservation and mitigation measures deemed necessary to respond to changed circumstances as provided for and specified in the HCP's adaptive management strategy (50 CFR 17.22(b)(5)(i and ii) and 50 CFR 17.32(b)(5)(i and ii). If these measures were not provided for in the HCP, and the HCP is otherwise being properly implemented, the USFWS will not require any conservation and mitigation measures in addition to those provided for in the HCP without the consent of the Applicant (50 CFR 17.22(b)(5)(i and ii) and 50 CFR 17.32(b)(5)(i and ii).

7.6 UNFORESEEN CIRCUMSTANCES AND "NO SURPRISES" POLICY

It is further acknowledged that circumstances may arise that are not fully contemplated by this HCP and that may result in substantial or adverse impacts to the biological status of any of the four subject species or their habitat. Such impacts may or may not be a result of the operation of the proposed facility. If and when the Applicant, USFWS, or DLNR become aware any circumstances that may affect any listed species and/or the ability of the Applicant to implement this HCP, all involved entities will be immediately notified and meet as soon as possible to discuss the circumstances and identify appropriate action.

In negotiating unforeseen circumstances, the USFWS will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed upon for the species covered by the HCP without the consent of the Applicant [50 CFR 17.22(b)(5)(iii) and 50 CFR 17.32(b)(5)(iii)]. If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, and the HCP is being properly implemented, the USFWS may require additional measures of the Applicant only if such measures are limited to modifications within conserved habitat areas, if any, or to the HCP's operating conservation program for the affected species, and maintain the original terms of the HCP to the maximum extent possible.

A "no surprises" policy provides that, in negotiating "unforeseen circumstances" provisions for HCPs, USFWS and DLNR shall not require the commitment of additional land or financial compensation beyond the level of mitigation that was otherwise adequately provided for the four listed species under the proper implementation of this HCP. Additionally, USFWS and DLNR will not seek, nor will the Applicant be required to provide, any other mitigation beyond that provided for in the adaptive management program covered by the original terms and conditions, and goals and objectives, of this HCP. Any such changes will be limited to measures that can be accomplished within the parameters of the existing wind energy generation facility and its operation and as agreed upon by the Applicant. Additional conservation and mitigation measures will not involve the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the HCP without the consent of the Applicant.

The "No Surprises" policy also provides that "if additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of a properly functioning HCP, the obligation for such measures shall not rest with the HCP permittee". Specific to this HCP, the Permittee will not have to mitigate for any increased take of nēnē (either assessed as direct take or indirect take) due to population or habitat enhancement measures (see Section 6.4.2.2 and 6.4.3.2) that may be conducted in the vicinity of the project as part of their mitigation requirements.

The USFWS and DLNR will have the burden of demonstrating that unforeseen circumstances exist, using the best scientific and commercial data available. These findings must be clearly documented and based upon reliable technical information regarding the status and habitat requirements of the affected species. The USFWS and DLNR will notify the Applicant in writing should the USFWS or DLNR believe that any unforeseen circumstance has arisen.

7.7 PERMIT DURATION AND AMENDMENTS

The Applicant proposes to have a HCP in effect for the duration of the wind energy generation facility's operation, which is anticipated to be 20 years.

7.7.1 Minor Amendments

Informal, minor amendments are permissible without a formal amendment process provided that the change(s) necessitating such amendment(s) does not cause a net adverse effect on any of the four Covered Species that is significantly different from the effects considered in the original HCP. Such informal amendments could include, but are not necessarily limited to, routine administrative revisions, changes to surveying or monitoring protocols that do not decrease the level of mitigation or increase take. A request for a minor amendment to the HCP may be made with written notice to USFWS and DLNR. A public review process may be required for the minor amendment. The amendment will be implemented upon receiving concurrence from the agencies.

7.7.2 Formal Amendments

Formal amendments are required if the change(s) necessitating such amendment(s) could produce a net adverse effect on any of the four Covered Species that is significantly different than any of those considered in the original HCP. For example, a formal amendment would be required if the documented level of take exceeds that covered by the HCP's adaptive management program.

A formal amendment also would be required if another listed species is found to occur in the project area and could be adversely affected by project activities. This HCP may be formally amended upon written notification to USFWS and DLNR with the same supporting information that was provided with the original application.

The need for a formal amendment must be determined at least one year before permit expiration, as a formal amendment may require additional baseline surveys and data collection, additional or modified minimization and/or mitigation measures, and/or additional or modified monitoring protocols; a supplemental NEPA evaluation; and additional public review.

7.7.3 Renewal or Extension

This HCP is proposed to be renewed or extended, and amended if necessary, beyond its initial 20-year term with the approval of USFWS and DLNR. The Applicant will submit a written request to both agencies, will either certify that the original information and conditions are still correct or provide a description of relevant changes, and will provide specific information concerning the level of take that has occurred under the HCP's implementation. Such a request shall be made within at least 180 days of the conclusion of the permit term, and the HCP shall remain valid and in effect while the renewal or extension is being processed. The permit may not be renewed for levels of take beyond those authorized by the original permit.

7.7.4 Other Measures

Issuance criteria under ESA section 10(a)(2)(B) authorize USFWS to obtain such other assurances as may be required that the HCP will be implemented. An Implementing Agreement stipulating the HCP's terms and conditions in contractual form will be signed by all parties (the Applicant, USFWS, and DLNR).

8.0 CONCLUSION

KWP II LLC looks forward to working with the USFWS and DLNR throughout the approval and long-term implementation of the HCP for the KWP II project. While commercial wind energy generation facilities are acknowledged to be environmentally friendly endeavors, they are not without potential negative environmental impacts. The Applicant is committed to making all **reasonable and appropriate** efforts to avoid, minimize, and compensate for these impacts as evaluated and determined through the HCP process and its adaptive management strategy.

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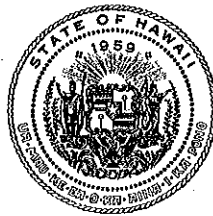
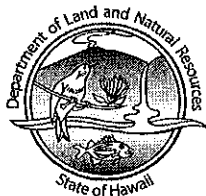
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Appendix 1



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

Office of Conservation and Coastal Lands
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

REF:OCCL:TM

CDUP: MA-3380

Perry White
Planning Solutions
Ward Plaza, Suite 330
210 Ward Avenue
Honolulu, Hawaii 96814-4012

JUL 20 2007

Dear Mr. White,

SUBJECT: Conservation District Use Permit (CDUP) MA-3380

This letter is to inform you that on July 20, 2007, the Chairperson of the Board of Land and Natural Resources, pursuant to Chapter 13-5, Hawaii Administrative Rules, approved Conservation District Use Application MA-3380 for Meteorological Measurement Towers Located at Located at Olowalu-Ukumehame, Lahaina/Wailuku, Maui, portions of TMK: (2) 4-8-001:001 and (2) 3-6-001:014 subject to the following conditions:

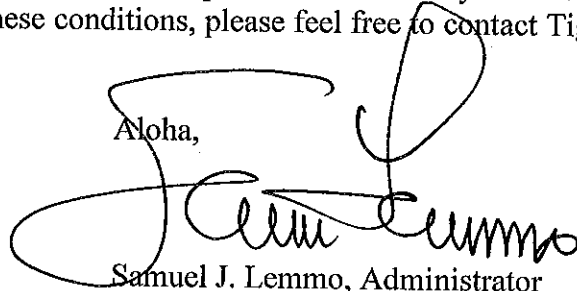
1. The applicant shall comply with all applicable statutes, ordinances, rules, and regulations of the Federal, State and County governments, and the applicable parts of Section 13-5-42, Hawaii Administrative Rules;
2. The applicant, its successors and assigns, shall indemnify and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury or death arising out of any act or omission of the applicant, its successors, assigns, officers, employees, contractors and agents for any interference, nuisance, harm or hazard relating to or connected with the implementation of corrective measures to minimize or eliminate the interference, nuisance, harm or hazard;
3. The applicant shall comply with all applicable Department of Health administrative rules;
4. Where any interference, nuisance, or harm may be caused, or hazard established by the use the applicant shall be required to take measures to minimize or eliminate the interference, nuisance, harm, or hazard within a time frame and manner prescribed by the Chairperson;

5. Any work done on the land shall be initiated within one year of the approval of such use, and unless otherwise authorized be completed within three years of the approval. The applicant shall notify the Department in writing when construction activity is initiated and when it is completed;
6. Should an impact with flying wildlife occur, KWP II shall remove the tower(s) until such time as the tower(s) are covered by an Incidental Take License and accompanying (amended) Habitat Conservation Plan;
7. Before proceeding with any work authorized by the Board, the applicant shall submit four (4) copies of the construction and grading plans and specifications to the Chairperson or his authorized representative for approval for consistency with the conditions of the permit and the declarations set forth in the permit application. Three (3) of the copies will be returned to the applicant. Plan approval by the Chairperson does not constitute approval required from other agencies;
8. The applicant shall obtain a land disposition from the Land Division for the proposed use;
9. In issuing this permit, the Department has relied on the information and data that the applicant has provided in connection with this permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Department may, in addition, institute appropriate legal proceedings;
10. Should historic remains such as artifacts, burials or concentration of charcoal be encountered during construction activities, work shall cease immediately in the vicinity of the find, and the find shall be protected from further damage. The contractor shall immediately contact SHPD (692-8015), which will assess the significance of the find and recommend an appropriate mitigation measure, if necessary;
11. The applicant understands and agrees that this permit does not convey any vested rights or exclusive privilege;
12. Best management practices for prevention of introducing exotic species to the site shall be observed;
13. Upon the end of the duration of data collection or the end of the equipment lifecycle or within three years, all equipment shall be removed and the land shall be restored to its original condition;
14. The applicant acknowledges that the approved work shall not hamper, impede or otherwise limit the exercise of traditional, customary or religious practices in the immediate area, to the extent such practices are provided for by the Constitution of the State of Hawaii, and by Hawaii statutory and case law;
15. Other terms and conditions as may be prescribed by the Chairperson; and

16. Failure to comply with any of these conditions shall render this Conservation District Use Permit null and void.

Please acknowledge receipt of this approval, with the above noted conditions, in the space provided below. Please have an authorized signature sign two copies. Retain one and return the other within thirty (30) days. A copy of the Staff report is included for your information. Should you have any questions on any of these conditions, please feel free to contact Tiger Mills at 587-0382.

Aloha,



Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

Receipt acknowledged:

Applicant's Signature

Date _____

c: Chairperson
Maui Board Member
Maui District Land Office
County of Maui, Department of Planning

Appendix 2

KWP II Post-Construction Monitoring Protocol

Sampling to estimate the mortality occurring at a wind energy facility must consider spatial and temporal factors at different scales. At the scale of the individual turbine, the area searched should encompass the majority of where expected mortalities will fall; in addition, the search interval has to be of a frequency where most carcasses will be discovered before they are scavenged. When spatial and temporal variation within a site are considered, individual turbines within a site should be sampled sufficiently to account for the spatial variation that exists among turbines, as well as across seasons of the year when species of interest are at the greatest risk of turbine collision.

The accuracy of a mortality estimate itself depends on several factors. The probability of finding a carcass depends on the search interval and scavenging rates at the site. Scavenging rates are typically estimated by conducting trials to yield representative carcass retention times and search intervals are then adjusted accordingly. Another factor that determines the probability of finding a carcass is searcher efficiency. Searcher efficiency will account for individuals that may be killed by collision with project components but that are not found by searchers for various reasons, such as heavy vegetation cover.

This monitoring protocol outlines the scavenger and searcher efficiency trials that KWP II will conduct as well as the search methods that will be used to locate carcasses impacted by the operation of the wind facility.

EARLY POST-CONSTRUCTION STUDIES

The field methods proposed below are based primarily on a refinement of the methods that have been used at KWP since operations began in June 2006 (Kaheawa Wind Power 2006). Other recent studies of bird and bat fatalities at wind power projects in the U.S. and Europe were also reviewed to develop and refine previously-approved methods and search techniques (e.g., Kerns and Kerlinger 2004, Pennsylvania Game Commission 2007, Stantec 2008, Stantec 2009, Arnett 2005, Jain et al. 2007, Fiedler et al. 2007).

The initial period of fatality monitoring at KWPII will entail frequent, systematic searches of the area beneath each turbine by trained technicians. Carcass removal and searcher efficiency trials will be conducted within this period. Subsequently, systematic sampling at a pre-determined reduced effort will be conducted for one year at 5-year intervals with attendant SEEF trials and carcass removal trials. A regular rapid assessment technique will be developed for the interim years to determine direct take occurring between years of systematic monitoring.

Factors Considered for Scavenger and Searcher Efficiency (SEEF) Trials

Factors that may affect the results of scavenger and SEEF trials include seasonal differences, vegetation types and carcass sizes.

Seasonal differences are presumed to affect the outcome of scavenger trials. The rate of carcass retention may vary due to seasonal changes in density of predators on site, or seasonal changes in predator behavior. For the monitoring protocol at KWP II, the year is divided into two seasons, the winter/spring season (December – May) and summer/fall (June – November). Scavenger trials already conducted at the adjacent KWP facility have suggested that scavenging rates vary with the two seasons identified above (Kaheawa Wind Power 2008). The outcome of SEEF trials are not expected to vary with season.

Different vegetation types are likely to affect the outcome of both scavenger and SEEF trials. It is anticipated that more complex vegetation structures will result in lower scavenging rates and lower searcher efficiency. Search plots at KWPII will consist either of bare ground or short stature grass and will be maintained throughout the life of the project.

Carcass sizes will also likely affect the outcome of both scavenger and SEEF trials. Three size classes have been established to reflect the size classes of the Covered Species: bat size, medium birds (seabirds) and large birds (nēnē). Based on studies conducted at KWP and elsewhere, it is expected that as size increases, both carcass retention times and searcher efficiency will increase.

Placement of Carcasses for Searcher Efficiency and Carcass Removal Trials

Each carcass used in searcher efficiency or carcass removal trials will be placed randomly within the search plots. These points will be generated within each identified vegetation zone using ArcView 9x with the Generate Random Points tool in Hawth's Analysis Tools 3.27. Parameters that will be specified for each randomly chosen location will include the minimum distance between random points and minimum distance of the point from the vegetation zone boundary. Minimum distances between random points will ensure that carcasses are not placed too close together. This will maintain the independence of the samples and prevent predator swamping. The distance of each point from the boundary of the vegetation zone will ensure that carcasses will be within the specified vegetation zone and not be placed on edges or within transition zones. These points will subsequently be loaded into a GPS as waypoints to allow the accurate placement of the carcasses.

Carcass Removal Trials

The objective of performing carcass removal studies at KWP II will be to determine the average amount of time an avian or bat carcass remains visible to searchers before being removed by scavengers or otherwise rendered undetectable. Carcass removal trials have been ongoing at the KWP facility since November, 2005. To date a total of 19 trials have been conducted using a variety of species and numbers of specimens, with carcass removal rates averaging 10.7 days (Kaheawa Wind Power 2009). Similar but more frequent trials will be conducted at KWP II with the purpose of maintaining an ongoing record of scavenging rates at different times of year, and among different vegetation types, that will best reflect site-specific conditions in the event that a take does occur. Eight to twelve carcass removal trials will be conducted during the initial survey year, designed to enable four to six trials within a corresponding season (summer/fall and winter/spring) and will be used to adjust the number of estimated direct takes of covered species observed by correcting for carcass removal bias.

Each carcass removal trial will consist of placing a pre-determined number of carcasses (up to a maximum of nine specimens) of varying size classes on the ground at random locations within representative vegetation classes. The carcass will be placed such that it approximates what would be expected if a bird/bat came to rest on the ground after having collided with an overhead structure. The intent will be to distribute trials along the length of the project area to represent a range of elevations, habitat conditions, vegetation cover types, and seasonal variability. Fresh carcasses will be used whenever available, if frozen carcasses are used, all carcasses will be thawed before being deployed. An example of a possible sampling design is presented in Table 1.

All carcasses will be checked on days daily for up to 30 days or until all evidence of the carcass is absent. On day 30, all remaining materials, feathers or parts will be retrieved and properly discarded. Results of trials provide a basis for determining the search frequency necessary to ensure that birds and bats are not scavenged before they can be detected by searchers (see Barrios and Rodriguez 2004 and Kaheawa Wind Power 2008). In some instances, carcasses may be monitored beyond the 30 day survey duration if the information being gathered substantially informs the conclusions of the monitoring exercise. Data will be analyzed by season, and according to vegetation and carcass size classifications.

Table 1. Possible Sampling Scheme for KWP II Scavenger Trials for One Season

Vegetation types	Season	Size class	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Total sample size
Bare ground	Winter / Spring	Bats	2		2		2		2		8
		Med birds	2		2		2		2		8
		Large birds		2		1		2		1	6
Grass	Winter / Spring	Bats	2		2		2		2		8
		Med birds	2		2		2		2		8
		Large birds		1		2		1		2	6
Total			8	3	8	3	8	3	8	3	44

Searcher Efficiency Trials (SEEF)

Searcher Efficiency (SEEF) Studies represent an important component of downed wildlife monitoring and provide an estimate of carcass detection probability. As with SEEF trials at KWP, trials will be conducted in association with the regular search effort to estimate the percentage of avian/bat fatalities that are found by searchers. Searcher efficiency will be evaluated according to vegetation classification and differences in carcass detection rates for different sized birds and for bats. Estimates of searcher efficiency will be used to adjust estimates of direct take by accounting for carcass detection bias.

Personnel conducting carcass searches will not be told when or where trials will be conducted. Trials will be administered during the twice weekly monitoring period but dates will be chosen randomly, as far as practicable. Each trial will consist of 3 - 8 bird carcasses and/or bats or bat surrogates. Prior to a search commencing, each carcass will be placed within chosen vegetation zones, as described above, at randomly selected locations that will be searched on the same day. Each trial carcass will be discreetly marked and located by GPS so it can be relocated and identified when found. If carcasses of the covered species are not available, carcasses of surrogate species will be used as previously described. Data will be analyzed according to vegetation and carcass size classifications. More trials will be conducted if analyses indicate that more trials are needed to provide statistical confidence in the resultant values and enable mean searcher detection probabilities to be ascertained for the project site.

Searcher efficiency rates at KWP using Wedge-tailed Shearwaters as surrogates for the two Covered seabird species have ranged from 62 - 67% in shrubs (n=79), to 81 - 82% in grass (n=136) to 97 - 100% detectability on bare ground (n=47). Using house sparrows as surrogates for bats at KWPII, the searcher efficiency rates ranged from 25 - 33% in shrubs (n=7), to 50 - 70% in grass (n=9) to 100% detectability on bare ground (n=12) (Kaheawa Wind Power 2009). Increasing the overall number and size range of surrogate specimens used in SEEF trials performed during the initial two years of study will provide a better representation of variability among differing vegetation and terrain conditions for the different sized Covered Species, resulting in greater confidence in this species-specific adjustment variable.

Procurement of Carcasses for Trials

If using state or federally protected species as surrogates for trials, all state and federal laws pertaining to transport, possession, and permitted use of these species along with appropriate animal use protocols will be followed. A scientific permit will be obtained for all species that may be used in trials. Carcasses used in the trials will be selected to best represent the size, mass, coloration, and if possible should be closely related to or roughly the same proportions as the four Covered Species. For example, Wedge-tailed shearwaters, a close taxonomic relative of the Hawaiian Petrel and Newell's Shearwater exhibit a close resemblance to both these covered seabird species, have been used successfully at KWP and elsewhere in carcass removal trials. All carcasses used for the trials will be fresh or freshly thawed. Dark colored mammals (e.g., small rats, mice) and small passerines (e.g. house finch, house sparrow) may be used as surrogates for bats. Other types of avian carcasses that may prove useful for trials include locally-obtained road kills, downed seabirds, owls, and waterbirds, or species not protected under the MBTA such as pheasant (*Phasianus colchicus*) and rock dove (*Columba livia*). Nēnē mortalities that occur elsewhere but render the carcasses available for these studies would provide an important opportunity to learn how long nēnē remain visible to searchers at KWP II. Use of species protected under ESA or MBTA will require permission from DLNR and USFWS.

Search Intervals

Consultation with the Endangered Species Recovery Committee (ESRC) and DLNR has indicated a preference for search intervals that is equal to approximately 50% of the mean carcass removal rate. While KWP II will be conducting its own carcass removal trials, similar

trials, in similar habitat, have already been conducted at the adjacent KWP facility. The mean carcass removal time at KWP was 10.7 days (n=19, Kaheawa Wind Power 2009). However, at the KWP site it appears that scavenging rates are higher in the winter and spring than in the summer and fall (Kaheawa Wind Power 2008). In order to comply with the request of ESRC and DLNR and account for variability in these removal rates, search intervals of 3 or 4 days were chosen. Thus, searches will be carried out twice a week at the KWP II turbines. These search intervals may be adjusted to more accurately reflect seasonal carcass removal rates as carcass removal trials are conducted and data indicate appropriateness of sampling design modifications.

Should SEEF trials indicate that carcass retention times are less than 7 days, trapping may be conducted to depress scavenger populations and increase carcass retention times. All applicable permits will be obtained.

Search Areas Beneath Meteorological Towers

The search area beneath the temporary met towers will be circular and extend 10 m beyond the supporting guy wires. The search area beneath the permanent unguyed met tower (80 m) will also be circular and be half the height of the tower at 40 m search radius.

Search Areas Beneath Individual Turbines

Several studies of small-bodied animals (songbirds and bats), with adequate sample sizes (n = 69 – 466), have shown that the majority of carcasses are found within a search area of less than 50% of the maximum turbine height (Arnett 2005, Jain et al. 2007, Fiedler et al. 2007; see Fig. 1a, b, 2a, b, c, d, e). Most of the carcass distributions (% fatalities vs. distance from turbine) appear to be well described by 2nd degree polynomials, with most fatalities found at approximately 25% of the distance of turbine height, then decreasing with few fatalities occurring beyond 50% of the maximum turbine height (Fig 2a, b, c).

These data are also supported by the distribution of carcasses that have been found at the operating KWP facility. To date, after more than 3000 turbine plot searches conducted during the three years operation at KWP, only seven carcasses have been found that are clearly attributable to collisions with the turbines. The carcasses consist of one Hawaiian hoary bat, one Hawaiian petrel, three nēnē, one barn owl, one Hawaiian short-eared owl, one ring-necked pheasant and one white-tailed tropicbird with distances from the turbine ranging from 2 – 87 m (2 – 97% of maximum turbine height at 90 m). Search plots for KWP are of 90 m radius (100% turbine height) and no intact carcasses were found beyond a distance of 50% turbine height, with the exception of the white-tailed tropicbird and Hawaiian short-eared owl where the main carcass was found at 56% and 67% turbine height respectively. Portions of the wing for both carcasses were also further away at 81% turbine height for the white-tailed tropic bird and 97% turbine height for the Hawaiian short-eared owl. It should not be ruled out that the wing material recovered in these cases may have been moved by scavengers.

Most of these studies have concentrated on the fatality distributions of small birds and bats. However, these fatality distributions are also expected to apply to larger bodied birds, though it is expected that larger-bodied birds, because of their greater weight, they will likely be found closer to the base of the turbines.

Given the considerations detailed above, it is proposed that search areas beneath individual turbines for KWP II consist of a combination of sample areas including 50% and 75% maximum turbine height (50 m and 75 m, radii, respectively).

Spatial and Temporal Sampling Scheme During the First Year of Intensive Sampling

Frequency of Sampling

Sampling at KWP II will consist of twice weekly carcass searches. The actual search intervals will be adjusted based on the results of the seasonal carcass removal trials as they become available. The search intervals will be determined in consultation with DLNR and USFWS.

Temporal Sampling Scheme

The first weekly search will consist of sampling all 14 turbines with a search area radius of 50% maximum turbine height (Figure 3A). The second search of the week will consist of sampling a randomly selected subset of seven turbines (Fig 3B) with a search area radius of 75% of maximum turbine height. Turbines are randomly chosen to reduce possible bias. The subsequent week, the other set of seven turbines will be searched to 75% maximum turbine height (Fig. 3C). The random selection of turbines will only be done once, prior to searches commencing at the project. The same subset of turbines will then be alternated each week for the remaining duration of the intensive sampling. As the rate of mortality for all Covered Species at KWPII is expected to be low, sampling all turbines twice weekly at the 50% maximum turbine height and a subsample of seven with a search area radius of 75% of turbine height will ensure a high probability that most of the mortality will fall within the search areas. The short search interval will also increase the probability that any carcasses will be found before they are removed by scavengers.

Plot Maintenance

All search plots will be maintained as bare ground or short stature grass (less than 24") for the life of the project.

Determining Spatial and Temporal Variation on Site

The twice weekly search frequency is anticipated to accurately describe variation in mortality rates at different turbines within the site, as well as identify periods when Covered Species that potentially occur year round on site (nēnē and Hawaiian hoary bat) are at greater risk of collision. Each turbine will be sampled 108 times a year, resulting in a total of 1512 turbine searches per year for the entire facility.

Intensive Sampling During the Second Year

Sampling intervals after the first year will be adjusted to reflect seasonal carcass retention rates measured by the scavenger trials. In addition, if sufficient data is collected and a reliable correction factor is obtained for the search area between 50 -75% maximum turbine height, all search plots may be reduced to 50% radius. The change in sampling regime will be determined by KWP II in consultation with DLNR, USFWS and members of the ESRC .

However, the same sampling regime as Year 1 will be continued if data indicates that more sampling is needed before any change can be made.

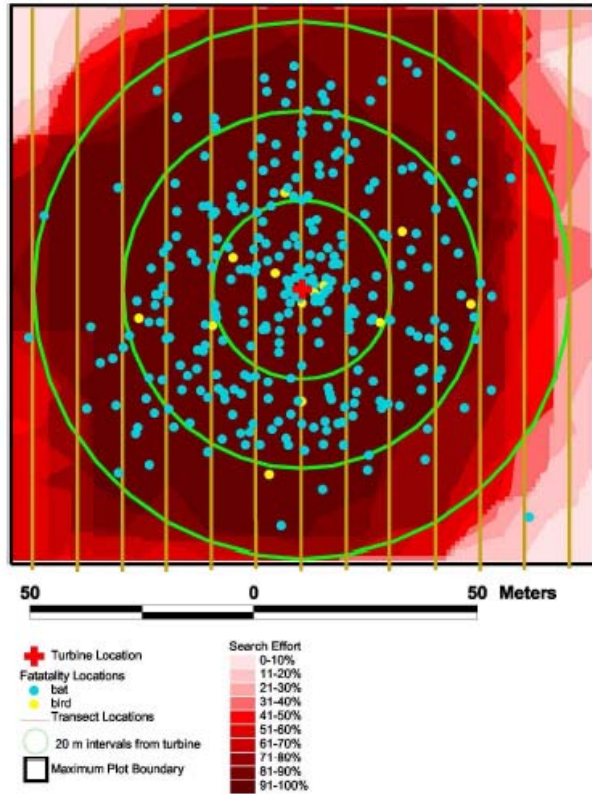


Figure 1a. Bat and bird fatalities (n=466 bats) at all turbines combined at Meyersdale Wind Energy Center in Pennsylvania, 2 August to 13 September 2004 (Arnett 2005). The maximum turbine height was 115 m.

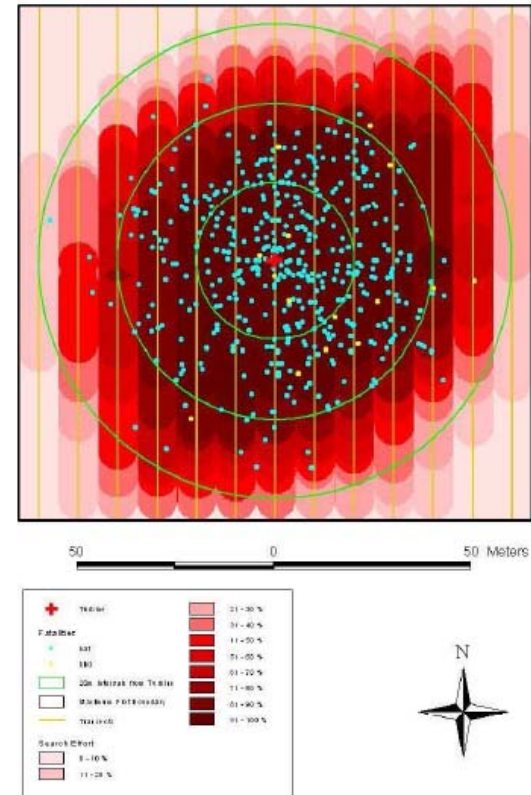
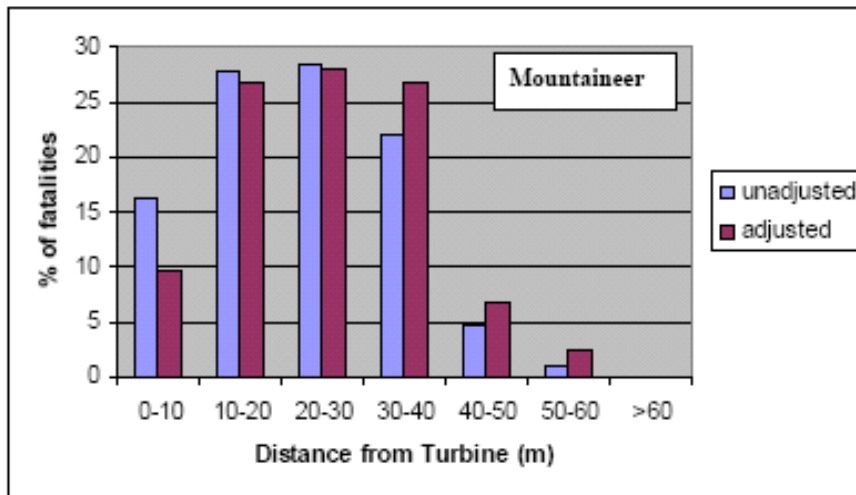
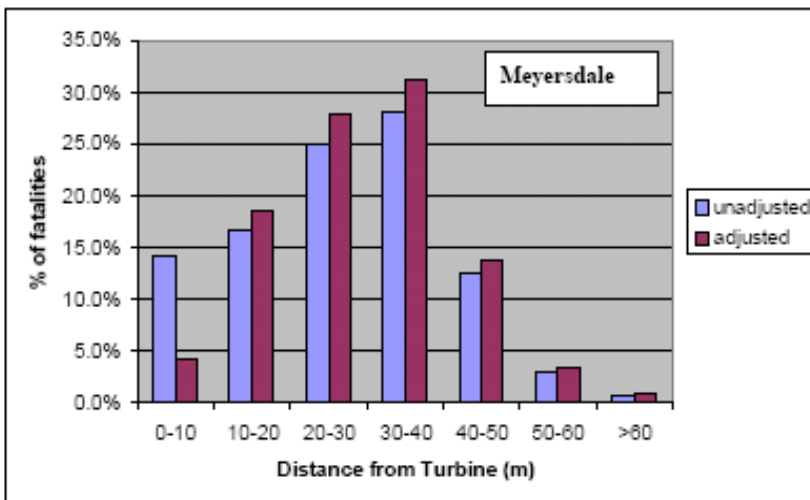


Figure 1b. Bat and bird fatalities (n=499 bats) at all turbines combined at Mountaineer Wind Energy Center in West Virginia, 31 August to 11 September 2004 (Arnett 2005). The maximum turbine height was 104.5 m.

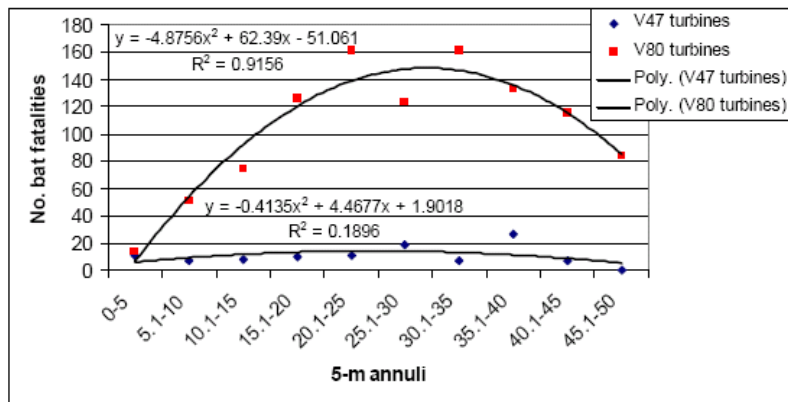


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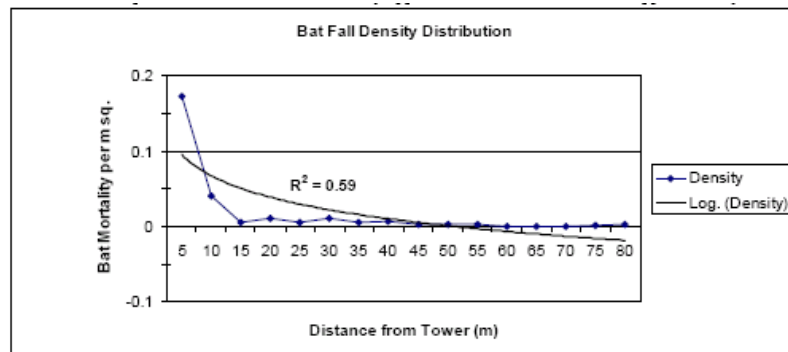


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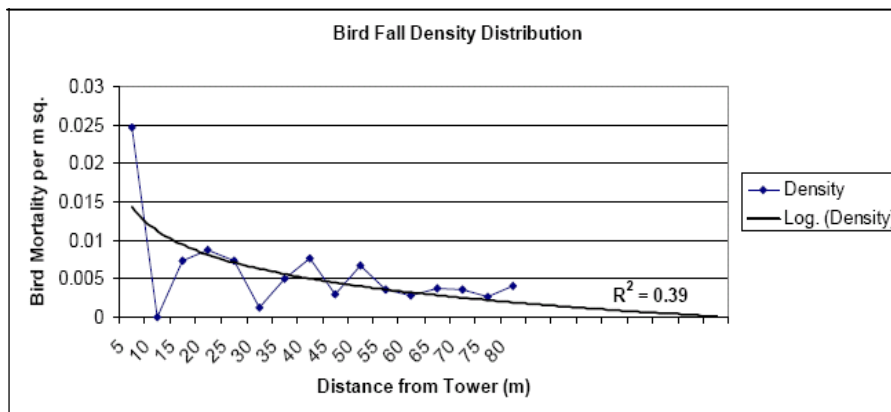
Figure 2a, b. Distribution of fatalities (birds and bats) as a function of distance from a turbine for Mountaineer and Meyersdale sites based on unadjusted counts, and counts adjusted for searcher detection and sampling effort (figures from Arnett 2005). The maximum turbine height was 104.5 m.



c



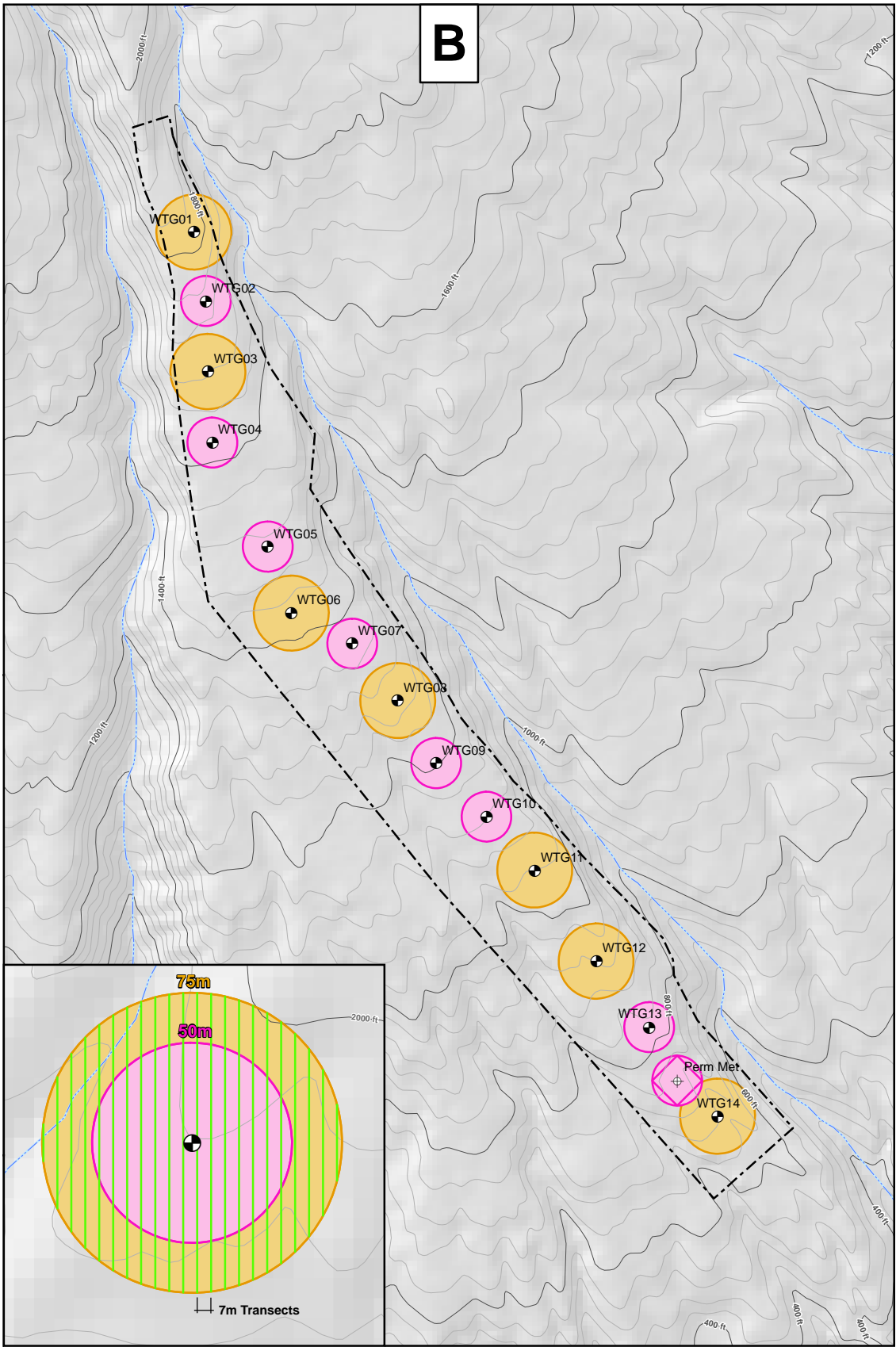
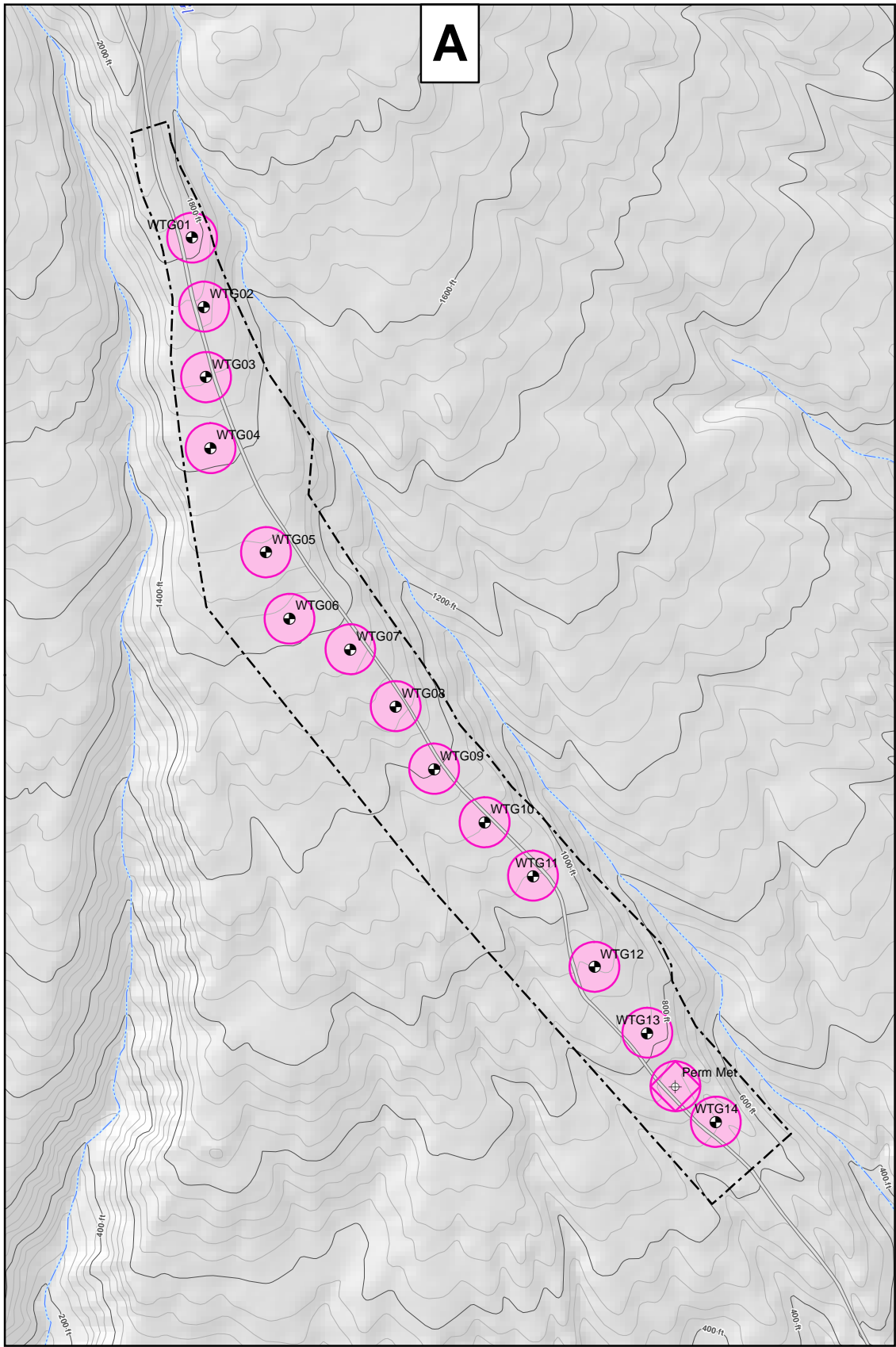
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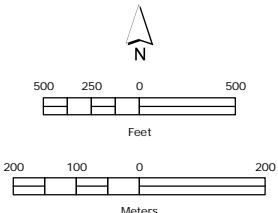
Figure 2c. Number of bats found within 5m annuli around V47 turbines ($n = 20$) and V80 turbine ($n=243$) from 5 April to 20 December 2005 and associated trend line for Buffalo Mountain, Tennessee (figure from Fielder et al 2007). The trend line for the V80 predicts that bat fatalities would reach zero at 59.6 m from the turbine (maximum turbine height is 120m). Data from the V47 is not considered in this report due to small sample sizes.

Figure 2d,e. Maple Ridge Wind Power, New York bat and bird fatality density distributions from September 1 to November 15, 2006, in relation to distance from towers with associated trend lines. The maximum turbine heights were 122 m (figures from Jain et al 2007). The trend lines predict that bird carcass densities approximate zero at 110m and at 45m for bats. The maximum turbine height was 122 m.



- Legend**
- KWP II Project Boundary
 - Proposed KWP II Structures**
 - Turbines
 - Met Tower
 - 50 Meter Radius Search Area
 - 75 Meter Radius Search Area
 - Streams
 - Contour Lines**
 - 200 ft Index
 - 40 ft Intermediate

Sources:
Site Layout - FirstWind
Topography and Streams - USGS



**Search
Areas**

Figure 3

Post Two-Year Intensive Sampling Period

Spatial and temporal trends on site should also be well understood at the end of the two-year intensive sampling period, enabling correction factors to be appropriately applied. Depending on findings, the correction factors may enable a decrease or modification of sampling effort (e.g. increase in search intervals or decrease in the number of turbines searched), identify specific turbines or times of the year when sampling effort should be concentrated, and inform adaptive management considerations. Discussion with ESRC, USFWS and DLNR has indicated a preference for the reallocation of effort whereby mitigation efforts are increased in exchange for a reduction in fatality monitoring. It is expected that the systematic monitoring effort will be scaled back by about 50%. It is also proposed that systematic fatality monitoring after the post two-year intensive sampling period be conducted at the beginning of 5-year bins; years 6, 11 and 16, resulting in a total of 5 years of systematic monitoring during the life of the project (Table 2). SEEF trials and carcass removal trials will be repeated during these years to determine if any of the variables have changed over time (Table 2). All adjustments to direct take will use the most recent estimates from the SEEF and carcass removal trials.

In addition to this reduced monitoring effort, regular rapid assessment (RRA) of each search plot will be conducted in the interim years. This may consist of personnel searching each plot to 75% turbine height on an ATV (all terrain vehicle). The frequency at which the surveys take place will be determined at the conclusion of the carcass removal trials for that 5-year period. SEEF trials will also be conducted to determine the searcher efficiency of the chosen RRA method. All adjustments to direct take found in the interim years will use the estimates from the SEEF and carcass removal trials for that 5-year time period.

The systematic monitoring during the first year of the 5-year period and the subsequent 4-year rapid assessment is designed to inform the Applicant if the take is still occurring at Baseline levels or whether take has moved to a Higher or Lower tier based on 5-year and 20-year take limits outlined in the HCP. Five-year total direct take levels will be determined for each 5-year bin while 20-year total direct take levels will be a cumulative total from the start of project operation.

This long-term sampling regime will be refined by KWPII in consultation with ESRC, USFWS, statisticians and wind energy experts after the initial 2-year intensive sampling period.

Years																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
IM1	IM2	RRA	RRA	RRA	SM	RRA	RRA	RRA	RRA	SM	RRA	RRA	RRA	RRA	SM	RRA	RRA	RRA	RRA
SEEF trials	SEEF trials	SEEF trials			SEEF trials	SEEF trials				SEEF trials	SEEF trials				SEEF trials	SEEF trials			
CRT					CRT					CRT					CRT				
1 st 5-year bin					2 nd 5-year bin					3 rd 5-year bin					4 th 5-year bin				

IM1 = intensive monitoring for year 1; IM2 = intensive monitoring for year 2; RRA = regular rapid assessment; SM= systematic monitoring
 CRT= carcass removal trials

Total direct take for 1st 5-year bin = total direct take for IM1 + total direct take for IM2 + total direct take for RRA years

Total direct take for subsequent 5-year bins = total direct take for SM + total direct take for RRA years

Table 2. Timetable for SEEF and scavenger removal trials and search techniques

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Appendix 3

**RADAR AND VISUAL STUDIES OF SEABIRDS AT THE PROPOSED
KWP II DOWN-ROAD ALTERNATIVE WIND ENERGY FACILITY,
MAUI ISLAND, HAWAII, SUMMER 2009**

BRIAN A. COOPER AND ROBERT H. DAY



PREPARED FOR
FIRSTWIND, LLC
NEWTON, MA

PREPARED BY
ABR, INC.-ENVIRONMENTAL RESEARCH AND SERVICES
FOREST GROVE, OREGON ♦ FAIRBANKS, ALASKA

**RADAR AND VISUAL STUDIES OF SEABIRDS AT THE
PROPOSED KWP II DOWN-ROAD ALTERNATIVE WIND ENERGY FACILITY,
MAUI ISLAND, HAWAII, SUMMER 2009**

FINAL REPORT

Prepared for

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EXECUTIVE SUMMARY

- We used radar and audiovisual methods to collect data on movements of endangered Hawaiian Petrels (*Pterodroma sandwichensis*) and threatened Newell's (Townsend's) Shearwaters (*Puffinus auricularis newelli*) at the proposed Kaheawa Wind Power II Down-road Alternative wind energy generation facility, on Maui Island during summer 2009. We conducted evening and morning surveys during 20–24 July 2009.
- The objectives of the study were to: (1) document movement rates of Hawaiian Petrels and Newell's Shearwaters at the proposed KWP II Down-road Alternative facility; (2) estimate the daily number of petrels/shearwaters that fly within areas that would be occupied by wind turbines at the proposed facility; and (3) estimate annual fatality rates of petrels/shearwaters at proposed turbines and meteorological (met) tower.
- We recorded 37 radar targets that fit our criteria for petrels and shearwaters.
- The mean movement rate across all nights was 1.78 ± 0.14 targets/h. After adjusting our sampling results for hours of the night that we did not sample (i.e., non-peak periods), we estimated a mean movement rate of 10.0 petrel-like/shearwater-like targets/night during summer 2009.
- We recorded one Hawaiian Petrel during visual sampling. This bird was heading east (i.e., toward Haleakala) at 40 m agl at 2126 on 24 July.
- To determine the risk of collision-caused mortality, we used petrel/shearwater movement rates observed on radar in summer 2009, petrel/shearwater flight altitudes from previous studies, and dimensions and characteristics of the proposed turbines and met towers to generate an estimate of exposure risk. We then applied estimates of the fatality probability (i.e., the probability of collision with a portion of the turbine or tower and dying while in the airspace occupied by the structure) and a range of estimated avoidance probabilities (i.e., the probability that a bird will detect and avoid entering the airspace containing the turbine or tower) to this estimate of exposure to calculate annual fatality rates that could be expected at the proposed turbines and met tower.
- We estimate that ~1,607 Hawaiian Petrels and 882 Newell's Shearwaters pass over the 1.5-km-radius radar sampling area in an average year (including birds at all altitudes).
- We estimated annual fatality rates at wind turbines and met towers by assuming that 90%, 95%, or 99% of all petrels/shearwaters flying near a turbine/tower will see and avoid the structure. Based on these scenarios, annual fatality rates for wind turbines ranged from 0.016–0.217 Hawaiian Petrel/turbine/yr and 0.009–0.119 Newell's Shearwaters/turbine/yr. For the 65-m met tower, we estimated a fatality of 0.008–0.081 Hawaiian Petrel/tower/yr and 0.004–0.044 Newell's Shearwaters/tower/year. Although the range of assumed avoidance rates of wind turbines and met towers (90–99%) is not fully supported by empirical data at this time we speculate that avoidance rates of petrels and shearwaters at wind farm structures (e.g., wind turbines and met towers) potentially are $\geq 95\%$, based upon fatality rates at existing windfarms and avoidance behavior of petrels observed at other structures (e.g., powerlines and communication towers); thus, we believe that fatality rates will be within the lower half of the range of estimates.

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INTRODUCTION

First Wind, LLC, formerly UPC Wind Management, LLC, operates the 30-MW Kaheawa Pastures Wind Energy Generation Facility, referred to as Kaheawa Wind Power I (KWP I), on the island of Maui (Figure 1). A new wind project adjacent to the existing facility is being considered for development by FirstWind and will be operated as Kaheawa Wind Power II (i.e., the KWP II Down-road Alternative). Two federally-listed seabird species occur on Maui: the endangered Hawaiian Petrel (*Pterodroma sandwichensis*; Hawaiian name 'Ua'u) and the threatened Newell's (Townsend's) Shearwater (*Puffinus auricularis newelli*; Hawaiian name 'A'o). Ornithological radar and night-vision techniques have been shown to be successful in assessing numbers and movement rates of these petrels and shearwaters on the Hawaiian Islands (e.g., Kaua'i [Cooper and Day 1995, 1998; Day and Cooper 1995, Day et al. 2003b], Maui [Cooper and Day 2003], Moloka'i [Day and Cooper 2002], and Hawai'i [Day et al. 2003a]). Previous radar and visual studies documented the presence of petrel/shearwater targets, including visual observations of Hawaiian Petrels, in the vicinity of the existing KWP I project site (Day and Cooper 1999, Cooper and Day 2004a). These data were used to model the potential number of annual fatalities at the KWP I development (Cooper and Day 2004b). In addition, radar studies were conducted in 2008 (Sanzenbacher and Cooper 2008, 2009) to model the potential number of fatalities in a nearby portion of an alternate KWP II site that was located just upslope of the KWP II Down-road Alternative.

The currently operational KWP I wind-energy facility consists of an articulated row of 20 1.5-MW turbines (GE 1.5se) with a hub height of ~55 m and a rotor diameter of 70.5 m, plus one 30-m-high, guyed NRG monopole meteorological (met) tower and two 55-m-high, guyed lattice met towers (Figure 2). The proposed KWP II Down-road Alternative project would consist of ~14 additional 1.5-MW turbines (GE 1.5se), each with a hub height of ~65 m and a rotor diameter of 70.5 m, plus one 65-m-high, free-standing met tower.

ABR conducted additional radar and visual studies on Maui in July 2009 with a specific focus

on an area proposed for the KWP II Down-road Alternative. The objectives of the study were to: (1) document movement rates of Hawaiian Petrels and Newell's Shearwaters at the proposed KWP II Down-road Alternative facility; (2) estimate the daily number of petrels/shearwaters that fly within areas that would be occupied by wind turbines or met towers at the proposed facility; and (3) estimate annual fatality rates of petrels/shearwaters at proposed turbines and meteorological (met) tower.

Background

Two seabird species that are protected under the Endangered Species Act (ESA) are likely and/or known to occur in the KWP II Down-road Alternative project area: the endangered Hawaiian Petrel and the threatened Newell's (Townsend's) Shearwater. The Hawaiian Petrel and the Newell's Shearwater are forms of tropical Pacific species that nest only on the Hawaiian Islands (American Ornithologists' Union 1998). Both species are Hawaiian endemics whose populations have declined significantly in historical times: they formerly nested widely over all of the Main Islands but now are restricted in most cases to scattered colonies in more inaccessible locations (Ainley et al. 1997b, Simons and Hodges 1998). The one exception is Kaua'i Island, where colonies still are widespread and populations are substantial in size. Of note, Kaua'i (along with Lana'i) also has no introduced Indian Mongooses (*Herpestes auropunctatus*) which prey on these seabirds.

The Hawaiian Petrel nests primarily on Maui (Richardson and Woodside 1954, Banko 1980a; Simons 1984, 1985; Simons and Hodges 1998, Cooper and Day 2003), Kaua'i (Telfer et al. 1987, Gon 1988, Day and Cooper 1995; Ainley et al. 1995, 1997a, 1997b; Day et al. 2003a), Hawai'i (Banko 1980a, Conant 1980, Hu et al. 2001, Day et al. 2003a), Lana'i (Shallenberger 1974; Hirai 1978a, 1978b; Conant 1980; G. Spencer and J. Penniman, pers. comm.), and Moloka'i (Simons and Hodges 1998, Day and Cooper 2002). On Maui, these petrels are known to nest on Haleakala Crater (Brandt et al. 1995, Simons and Hodges 1998) and are believed to nest in West Maui (Cooper and Day 2003), with recent observations of birds calling and exhibiting aerial displays consistent with breeding behavior, despite the



Figure 1. Maui Island, Hawaii, with approximate location of the Kaheawa Pastures Wind Energy Facilities (KWP I and KWP II).

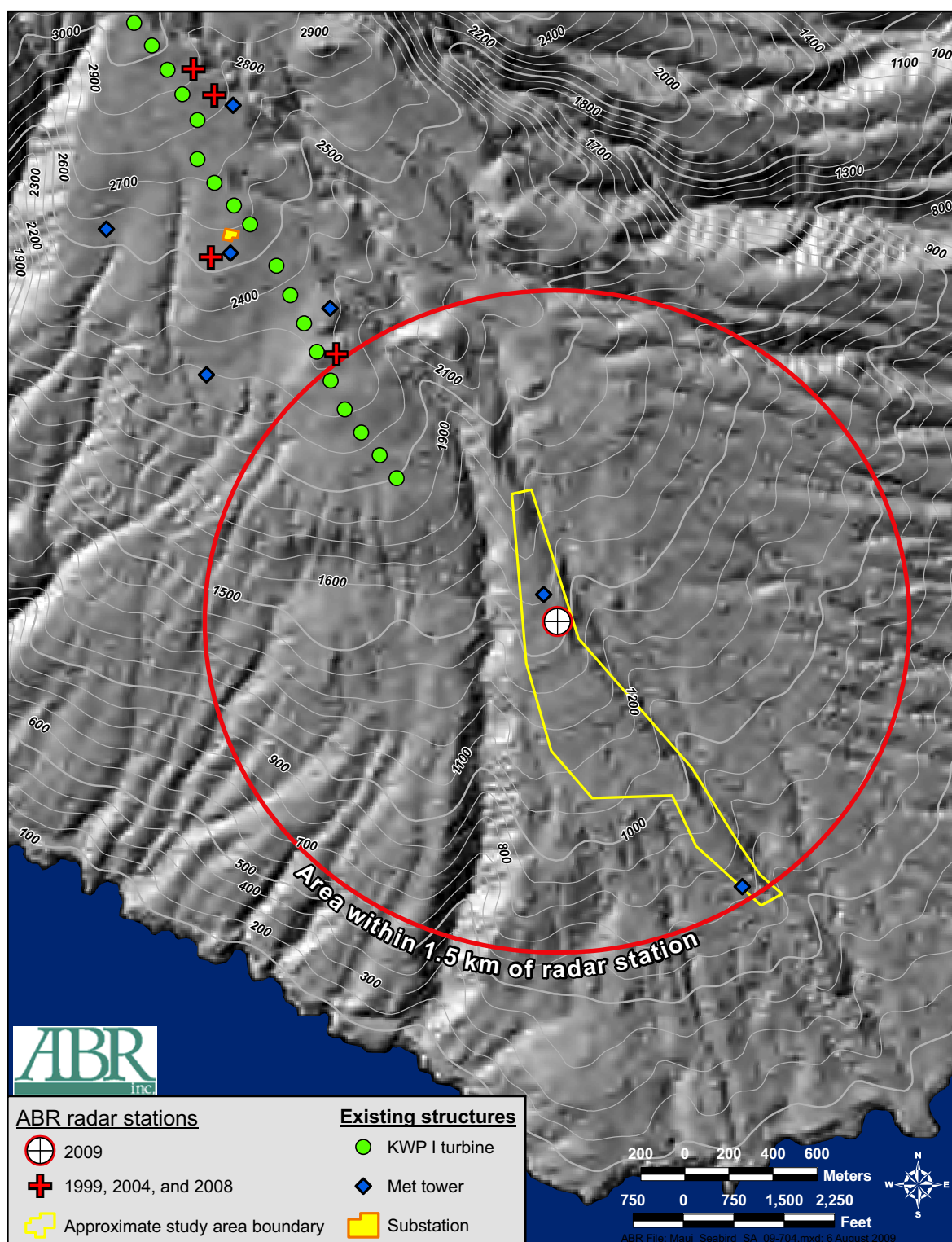


Figure 2. Location of 2009 radar sampling stations relative to sampling stations from previous studies (Day and Cooper 1999, Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009) and areas under consideration for siting of wind turbines at the proposed KWP II Down-road Alternative wind energy facility, Maui, Hawaii.

minimal historical evidence and introduction of Indian Mongoose on Maui. For example, on 16 June 1999, a Hawaiian Petrel was heard calling from a bed of uluhe ferns (*Dicranopteris linearis*) at 3,300 ft (~1,000 m) elevation in the Kapunakea Preserve, which lies on the northwestern slope of the West Maui Natural Area Reserve (A. Lyons, *vide* C. Bailey). In addition, recent observations of consistent calling from a single location suggests that there is another small colony of Hawaiian Petrels in the West Maui Mountains ~14 km north of the KWP project areas (G. Spencer, FirstWind, pers. comm.). On the other hand, daily movement rates of Hawaiian Petrels near KWP I and II (i.e., on the southern slope of West Maui Mountain; Day and Cooper 1999, Cooper and Day 2004a, Sanzenbacher and Cooper 2008 and 2009) are much lower than those over the eastern and northern sides of Maui (Cooper and Day 2003), suggesting that few birds use that area.

Newell's Shearwaters nest on several of the main Hawaiian Islands, with the largest numbers clearly occurring on Kaua'i (Telfer et al. 1987, Day and Cooper 1995; Ainley et al. 1995, 1997b; Day et al. 2003b). These birds also nest on Hawai'i (Reynolds and Richotte 1997, Reynolds et al. 1997, Day et al. 2003a), almost certainly nest on Moloka'i (Pratt 1988, Day and Cooper 2002), and may still nest on Oahu (Sincock and Swedberg 1969, Banko 1980b, Conant 1980, Pyle 1983; but see Ainley et al. 1997b). On Maui, recent auditory observations suggest that a small colony of Newell's Shearwaters is present in the west Maui Mountains ~14 km north of the KWP project areas (G. Spencer, FirstWind, pers. comm.), matching a prediction of their occurrence there by Cooper and Day (2003). Newell's Shearwaters typically nest on steep slopes that are vegetated by uluhe fern (*Dicranopteris linearis*) undergrowth and scattered o'hia trees (*Metrosideros polymorpha*).

There is interest in studying these two species because of concerns regarding collisions with structures such as met towers and turbines. To date, there is documented mortality of only one Hawaiian Petrel at a wind turbine and zero Newell's Shearwaters at wind-energy facilities (wind turbines or met towers) within the Hawaiian Islands (G. Spencer, FirstWind, pers. comm.). Note, however, that fatality studies have been conducted only for 3.5 yr at one wind-energy

location in the Hawaiian Islands (KWP I, Maui) and 3 mo at six met towers at the same site prior to operation. Hence, there have not been enough studies of adequate duration or geographic scope to answer the question definitively of whether these species are prone to collisions at these types of structures. There has, however, been well-documented petrel and shearwater mortality because of collisions with other human-made objects (e.g., transmission lines, communication towers) on Kaua'i (Telfer et al. 1987, Cooper and Day 1998, Podolsky et al. 1998) and Maui (Hodges 1992), and there have been collision-caused fatalities of other seabirds at other Hawaiian Islands (Fisher 1966).

STUDY AREA

The operational KWP I windfarm and proposed KWP II Down-road Alternative expansion are located on the southern slope of West Maui Mountain, in an area called Kaheawa Pastures (Figure 1). These sites lie on a moderately sloping portion of West Maui Mountain, ~1–6 km inland from McGregor Point. Vegetation at the site consists of non-native grasslands at lower elevations and a mixture of grasslands and scattered shrubs at moderate to higher elevations. Although the KWP II Down-road Alternative area consists of a dry Mediterranean habitat, vegetation becomes much wetter upland, toward the summit of West Maui Mountain. Presumably, vegetation communities also are dominated by native species in these higher, wetter areas. These upland habitats may provide suitable nesting habitat for Newell's Shearwaters, based on our experience on Kaua'i and other sites. In addition to the vegetation, the steepness of the land at higher elevations on West Maui Mountain also suggests that suitable nesting habitat exists for Hawaiian Petrels, as it does on Haleakala (Brandt et al. 1995), Kaua'i (Telfer, pers. comm.), and Lana'i (Hirai 1978b).

In previous studies at the KWP I and KWP II sites (Day and Cooper 1999, Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009), sampling was conducted at four other stations; however, for the current study, we established a new sampling station with a focus on providing maximal radar coverage of potential siting areas for the proposed KWP II Down-road Alternative

development (Figure 2). The study area is situated in lower elevations slightly to the east and south of the existing KWP I turbine string, and our 2009 sampling station was located adjacent to the existing KWP I access road, just south of the Lahaina Pali trail (20° 47'52.6" N, 156° 32'16.5" W; elevation ~490 m).

METHODS

We used marine radar and visual equipment to collect data on the movements, flight behaviors, and flight altitudes of petrels and shearwaters at a single sampling station during summer (20–24 July) 2009 (Table 1). The daily sampling effort consisted of 3 h each evening (1900–2200 h) and 2 h each morning (0400–0600 h). These sampling periods were selected to correspond to the evening and morning peaks of movement of petrels and shearwaters, as described near breeding colonies on Kaua'i (Day and Cooper 1995). During sampling, we collected radar and audiovisual data concurrently so the radar operator could help the audiovisual observer locate birds for species identification and data collection. In return, the

audiovisual observer provided information to the radar operator on the identity and flight altitude of individual targets (whenever possible). For the purpose of recording data, a calendar day began at 0700 and ended at 0659 the following morning; that way, an evening and the following morning were classified as occurring on the same day.

The ornithological radar used in this study was a Furuno (Model FCR-1510) X-band radar transmitting at 9.410 GHz through a slotted wave guide with a peak power output of 12 kW; a similar radar unit is described in Cooper et al. (1991) and Mabee et al. (2006). The antenna face was tilted upward by ~10°, and we operated the radar at a range setting of 1.5 km and a pulse-length of 0.07 μ sec.

Issues associated with radar sampling include ground clutter and shadow zones. Whenever energy is reflected from the ground, surrounding vegetation, and other objects around the radar unit, a ground-clutter echo that can obscure targets of interest (i.e., birds) appears on the radar's display screen. Shadow zones are areas of the screen where birds can fly at an altitude that potentially would

Table 1. Sampling dates and number of inbound and outbound seabird radar targets and number of audio-visual observations of species of interest at the proposed KWP II Down-road Alternative wind-energy site, Maui, Hawaii, July 2009.

Date	Site	Period	Number of radar targets			Number of audio-visual detections ²
			Inbound ¹	Outbound ¹	Total	
20 July	Lower	Eve	0	7	7	0
		Morn	0	1	1	0
21 July	Lower	Eve	0	5	5	0
		Morn	1	2	3	0
22 July	Lower	Eve	4	0	4	3 SEOW
		Morn	1	0	1	1 TROP
23 July	Lower	Eve	6	1	7	3 SEOW
		Morn	1	0	1	2 SEOW, 1 BAOW, 1 UNOW
24 July	Lower	Eve	6	0	6	1 HAPE, 1 BAOW, 1 UNOW
		Morn	1	1	2	1 SEOW

¹ Flight direction categories for landward and seaward categories included all birds flying toward and away, respectively, from either the colonies located on the opposite end of west Maui to the north of the study site or colonies on Haleakala.

² HAPE = Hawaiian Petrel; HOBA = Hoary Bat; NESH = Newell's Shearwater; SEOW = Short-eared Owl; BAOW = Barn Owl; TROP = unidentified Tropicbird; UNOW = Unidentified owl.

put them behind a hill or row of vegetation where they could not be detected because the radar operates only on line-of-sight. We attempted to minimize ground clutter and shadow zones during the selection of radar sampling stations; various structures and landscape features visible on radar indicated that our sampling stations provided good coverage of the study area.

We sampled for six 25-min sessions during each evening and for four 25-min sessions each morning (Table 1). Each 25-min sampling session was separated by a 5-min break for collecting weather data. To help eliminate non-target species, we collected data only for those targets that met a suite of selection criteria, following methods developed by Day and Cooper (1995), that included appropriate flight characteristics and flight speeds (≥ 30 mi/h [≥ 50 km/h]). We also removed radar targets identified by flight characteristics or visual observers as being of other bird species.

We conducted audiovisual sampling for birds and bats concurrently with the radar sampling to help identify targets observed on radar and to obtain flight-altitude information. During this sampling, we used 10X binoculars during crepuscular periods and Generation 3 night-vision goggles (Model ATN-PVS7; American Technologies Network Corporation, San Francisco, CA) during nocturnal periods. The magnification of the night-vision goggles was 1X, and their performance was enhanced with the use of a 3-million-Cp floodlight that was fitted with an IR filter to avoid blinding and/or attracting birds. Audiovisual observations were conducted within 25 m of the radar to facilitate coordination between observers, and we also listened for petrel and shearwater vocalizations.

Before each 25-min sampling session, we also collected environmental and weather data, including:

- wind speed (to the nearest 1.6 km/h [1 mi/h]);
- wind direction (to the nearest 1°);
- percent cloud cover (to the nearest 5%);
- cloud ceiling height, in meters above ground level (agl; in several height categories);

- visibility (maximal distance we could see, in categories);
- light condition (daylight, crepuscular, or nocturnal, and with or without precipitation)
- precipitation type; and
- moon phase/position (lunar phase and whether the moon was above or below the horizon in the night sky).

For each appropriate radar target, we recorded the following data:

- species (if identified by visual observer);
- number of birds (if identified by visual observer);
- time;
- direction of flight (to the nearest 1°);
- cardinal transect crossed (000°, 090°, 180°, or 270°);
- tangential range (the minimal perpendicular distance to the target when it passed closest to the radar; used in reconstructing actual flight paths, if necessary);
- flight behavior (straight, erratic, circling);
- velocity (to the nearest 5 mi/h [8 km/h]); and
- flight altitude (meters agl, if identified by visual observer).

For each bird (or bat) recorded during audiovisual sampling, we recorded:

- time;
- species (to the lowest practical taxonomic unit [e.g., Hawaiian Petrel, unidentified petrel/shearwater]);
- number of individuals composing each target;
- ordinal flight direction (000°, 045°, 090°, 135°, 180°, 225°, 270°, 315°); and
- flight altitude (meters agl).

For any birds heard but not observed, we recorded species, number of calls, direction of calls, and approximate distance.

DATA ANALYSIS

We entered all radar and visual data into Microsoft Excel databases. Data files were checked visually for errors after each night's sampling, then were checked electronically for irregularities at the end of the field season, prior to data analyses. In addition, radar data were filtered to remove non-target species, and only known petrel/shearwater targets or unknown targets with appropriate characteristics (i.e., target size, flight characteristics, and airspeeds ≥ 30 mi/h) were included in data analyses. Airspeeds were calculated by correcting observed target flight speeds (groundspeeds) for speed and relative direction of wind, as measured each half-hour at the radar station (Mabee et al. 2006).

We tabulated counts of numbers of radar targets of petrels and shearwaters recorded during each sampling session, then converted those counts to estimates of movement rates of birds (radar targets/h), based on the number of minutes sampled. No sampling time was lost to rain or other factors; we standardized estimates by actual minutes of sampling effort each half hour. We used all of the estimated movement rates across sampling sessions at a station to calculate the mean \pm 1 standard error (SE) nightly movement rate of petrels and shearwaters by station and pooled data across nights to derive an overall hourly movement rate for the study.

We also classified general flight directions of each radar target as landward or seaward and summarized those directional categories by station, date, and time period. To categorize the general flight direction of each target, we defined a landward flight as a radar target flying toward the West Maui Mountains or Haleakala (on East Maui) and classified targets flying in the opposite directions as seaward targets.

MODELING FATALITY RATES

The risk-assessment technique that we have developed involves the use of radar data for estimating the fatality rates for petrels and shearwaters near structures in the Hawaiian Islands. This modeling technique uses the radar data on seasonal movement rates to estimate numbers of birds flying over the area of interest (sampling station) across a 255-d year (for

Hawaiian Petrels) or a 210-d year (for Newell's Shearwater) when breeding birds are present on the island. The model then uses information on the physical characteristics of the structures (e.g., wind turbines or met towers) themselves to estimate horizontal and vertical interaction probabilities and combines these interaction probabilities with the movement rates to generate exposure rates (Figure 3). These rates represent the estimated numbers of petrels/shearwaters that pass within the airspace occupied by a proposed wind turbine or within the airspace occupied by a met tower and its associated guy wires each year. We then combine these exposure rates with (1) the probability that an interaction results in fatality, and (2) the probability that birds detect structures and avoid interactions, to estimate fatality rates.

We calculate an exposure rate by multiplying the seabird movement rate observed on radar by horizontal- and vertical-interaction probabilities. The movement rate is an estimate of the average number of birds passing in the vicinity of the proposed turbines/towers in a day, as indicated by numbers of targets on the radar screen and the mean flock size/target. It is generated from the radar data by: (1) multiplying the average movement rates by 5.0 h to estimate the number of targets moving over the radar site in the first 3 h and last 2 h of the night (i.e., during the peak movement periods of petrel/shearwaters); (2) adjusting the sum of those evening and morning counts to account for the estimated percentage of movement that occurs during the middle of the night (when we did not sample); and (3) multiplying that total number of targets/night by the mean number of seabirds/target to generate an estimate of the number of petrel/shearwaters passing in the vicinity of the proposed met towers/turbines during an average day.

We used the radar-based movement data from our current study at the proposed KWP II Down-road Alternative development to estimate seabird movement-rates in summer and assumed that those rates represented average rates observed in an average year. We used data from all-night sampling sessions on Kaua'i (Day and Cooper 1995) to estimate movement rates occurring during the hours between our evening and morning sampling periods. These data suggested that an additional 12.6% of the total combined evening

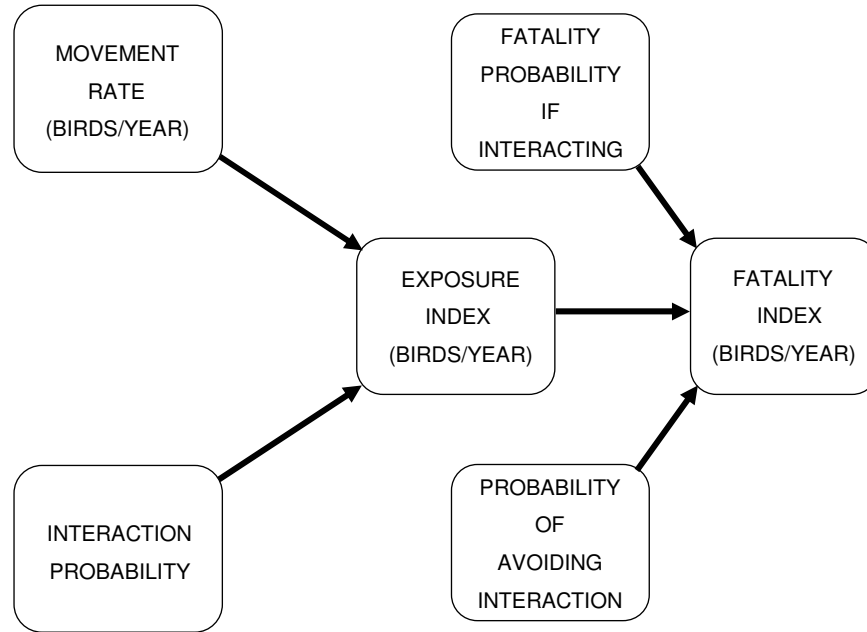


Figure 3. Major variables used in estimating possible fatalities of Hawaiian Petrels and Newell's Shearwaters at wind turbines at the proposed KWP II Down-wind Alternative wind energy facility, Maui, Hawaii. See Tables 2 and 3 for details on calculations.

landward movements and seaward morning movements occurred between the evening and morning peak-movement periods (Day and Cooper, unpubl. data). We also corrected the number of targets for flock size: mean flock sizes of petrels and shearwaters combined in Hawai'i are $1.05 \pm \text{SE } 0.01$ birds/flock ($n = 2,062$ flocks; Day and Cooper, unpubl. data). In addition, we used the timing of inland flights at the nearby Ukumehame site from Cooper and Day (2003) to correct for proportions of targets that were Hawaiian Petrels and those that were Newell's Shearwaters; those data suggested that 60% of the targets were Hawaiian Petrels and 40% of the targets were Newell's Shearwaters.

The number of petrels visiting breeding colonies tends to decline from summer to fall because attendance at colonies by nonbreeders and failed breeders declines as chick-rearing progresses (Serventy et al. 1971, Warham 1990, Ainley et al. 1997b, Simons and Hodges 1998). Although we do not yet have fall data for the site, we split the 255-d breeding season for Hawaiian Petrels (Simons and

Hodges 1998) and 210-d breeding season for Newell's Shearwaters (Ainley et al. 1997b) into a spring/summer period of 180 days and 150 days for petrels and shearwaters, respectively, and a fall period of 75 days and 60 days for petrels and shearwaters, respectively. We corrected the seasonal estimates of nightly movement rates by the numbers of days for the spring/summer and fall seasons to generate estimates of movements for each season and species. We assume that the sum of these two estimates represents estimated movement rates for an entire breeding season (i.e., an average year).

Because the resulting estimate of the number of birds/yr is not an integer, we then round it upward to the next whole number to generate an estimate of the average number of birds passing within 1.5 km of the radar site during a year. This rounding technique results in slightly-inflated fatality estimates, but we choose to take a conservative approach in these studies associated with endangered species.

INTERACTION PROBABILITIES

Horizontal

Interaction probabilities consist of horizontal and vertical components. The horizontal-interaction probability is the probability that a bird seen on radar will pass through or over the airspace occupied by a met tower or turbine located somewhere on the radar screen. This probability is calculated from information on the two-dimensional area (side view) of the tower/turbine and the two-dimensional area sampled by the radar screen to determine the interaction probability. The 65-m, free-standing met-tower system consists of a central lattice tower without any supporting guy wires. The tower is 65 m high with a width at the base of ~6 m and a width at the top of ~0.5 m. The proposed wind turbines have ~65-m monopole towers and 35.25-m-long blades. Two calculations of area were made for turbines because of the large differences in area of the structure that depended on the orientation of the blades relative to the flight path of an approaching bird: a minimal area occupied by each proposed turbine if a bird approaches it from the side (i.e., side profile) and a maximal area occupied by each turbine if a bird approaches it from the front (i.e., front profile, including the rotor-swept area). The ensuing ratio of cross-sectional area of the proposed tower/turbine to the cross-sectional area sampled by the radar (1.5 km) indicates the probability of interacting with (i.e., flying over or through the airspace occupied by) the proposed tower or turbine.

Vertical

The vertical-interaction probability is the probability that a bird seen on radar will be flying at an altitude low enough that it might pass through the airspace occupied by a proposed met tower/turbine located somewhere on the radar screen. This probability is calculated from data on flight altitudes and from information on the proposed turbine heights. We used data from throughout the Hawaiian Islands ($n = 2,010$ birds; Cooper and Day, unpubl. data) to calculate the percentage of petrels/shearwaters with flight altitudes at or below the maximal height of the turbines (i.e., $51.0\% \leq 100$ m agl) and met towers (i.e., $33.0\% \leq 65$ m agl). We would have preferred

to use flight-altitude data from the project area for the flight-altitude computations, but adequate sample sizes do not currently exist to do so.

FATALITY RATES

The annual estimated fatality rate is calculated as the product of: (1) the exposure rate (i.e., the number of birds that might fly within the airspace occupied by a tower/turbine); (2) the fatality probability (i.e., the probability of collision with a portion of the tower/turbine and dying while in the airspace occupied by the structure); and (3) the avoidance probability (i.e., the probability that a bird will detect and avoid entering the airspace containing the tower/turbine). The annual fatality rate is generated as an estimate of the number of birds killed/yr as a result of collisions with the tower/turbine, based on a 255-d breeding season for Hawaiian Petrels and a 210-d breeding season for Newell's Shearwaters.

Fatality Probability

The estimate of the fatality-probability portion of the fatality rate formula is derived as the product of: (1) the probability of dying if a bird collides with a tower/turbine; and (2) the probability of colliding with a turbine if the bird enters the airspace occupied by the structure (i.e., are there gaps big enough for birds to fly through the structure without hitting any part of it). Because any collision with a wind turbine or tower falls under the ESA definition of "take" we used an estimate of 100% for the first fatality-probability parameter. Note that the actual probability of fatality resulting from a collision is less than 100% because of the potential for a bird to hit a turbine component and not die (e.g., a bird could brush a wingtip but avoid injury/death). The second probability (i.e., striking the structure) needs to be calculated differently for met towers and turbines. In the met-tower design, the tower frame is a lattice structure, so we conservatively estimated the probability of hitting the tower if the bird enters the airspace at 100%. Similarly, a bird approaching a wind turbine from the side has essentially a 100% probability of getting hit by a blade; in contrast, a bird approaching from the back or front of a turbine may pass through the rotor-swept area without colliding with a blade, if it is flying fast enough. We calculated the probability of collision

for the “frontal” bird approach based upon the length of a petrel (43 cm; Simons and Hodges 1998); the average groundspeed of petrels on Maui (mean velocity = 42.5 mi/h; $n = 347$ probable petrel targets; Cooper and Day, unpubl. data) and the time that it would take a 43-cm-long petrel to travel completely through a 2-m-wide turbine blade spinning at its maximal rotor speed (22 revolutions/min); also see Tucker (1996). These calculations indicated that 19.5% of the disk of the rotor-swept area would be occupied by a blade sometime during the length of time (i.e., 0.13 sec) that it would take a petrel to fly completely past a rotor blade (i.e., to fly 2.43 m).

Avoidance Probability

The final parameter is the avoidance probability, which is the probability that a bird will see the turbine and change flight direction, flight altitude, or both, so that it completely avoids flying through the space occupied by a met tower/turbine. Because avoidance probabilities are largely unknown, we present fatality estimates for a range of probabilities of collision avoidance by these birds by assuming that 90%, 95%, or 99% of all petrels or shearwaters flying near a tower/turbine structure will detect and avoid it. See discussion for explanation of avoidance rates used.

RESULTS

VISUAL OBSERVATIONS

One Hawaiian Petrel was detected by visual observers (Table 1). This bird was heading eastward toward Haleakala at 40 m agl at 2126 on 24 July. That bird also was observed on radar. In addition, we had numerous observations of Short-eared Owls (*Asio flammeus sandwichensis*; Pueo), plus a few Barn Owls (*Tyto alba*), and one unidentified tropicbird (at 0542 on 22 July). No Hawaiian Hoary Bats (*Lasiurus cinereus semotus*; 'Ope'ape'a) were recorded.

MOVEMENT RATES

We recorded 37 radar targets during 25.0 h of sampling in summer 2009 that fit our criteria for petrels and shearwaters (Table 1). Passage rates tended to be higher in the evening than in the morning: only 8 (21.6%) of the 37 targets were

recorded during the morning sampling period. Mean nightly movement rates during summer 2009 were 1.78 ± 0.14 targets/h. After adjusting our sampling results for hours of the night that we did not sample (i.e., non-peak periods), we estimated a mean movement rate of 10.0 petrel-like targets/night during summer 2009 (Table 2).

We observed two different patterns of movement that depended on wind strength. During 20 and 21 July, there were strong Trade Winds (i.e., with average wind speeds mostly 20–35 mi/h), and we observed a pattern of 5–7 outbound targets in the evening followed by lower numbers of outbound targets in the morning (Table 1; Figure 4). During the final three nights of sampling, the winds were light (i.e., with average wind speeds mostly 0–5 mi/h [i.e., below turbine cut-in speed, since the KWP I turbine blades were not spinning]) and we observed a pattern of 4–6 inbound targets in the evening and lower numbers of targets in the morning (Table 1; Figure 5). Further, there appeared to be a shift in the spatial distribution of birds during low wind conditions that was not seen during strong winds: during the low winds, the majority of the inbound targets flew over the lower half of the proposed turbine string, and all were heading in the general direction of breeding colonies on Haleakala—not West Maui Mountain.

EXPOSURE RATES

The exposure rate is calculated as the product of three variables: annual movement rate, horizontal-interaction probability, and vertical-interaction probability. As such, it is an estimate of the number of birds flying in the vicinity of the wind turbine/met tower (i.e., crossing the radar screen) that could fly in a horizontal location and at a low-enough altitude that they could interact with a tower/turbine. Based on our summer 2009 movement rate data, we estimate that ~1,607 Hawaiian Petrels and 882 Newell's Shearwaters pass over the 1.5-km-radius radar sampling area in an average year (including birds at all altitudes; Tables 2 and 3). To generate annual exposure rates of birds exposed to each turbine or met tower (e.g., birds/tower/yr), we then multiplied the annual movement rate by the horizontal-interaction probability and the vertical-interaction probability. By applying those proportions to our data (and

Table 2. Estimated average exposure rates and fatality rates of Hawaiian Petrels (HAPE) and Newell's Shearwaters (NESH) at GE 1.5se wind turbines at the proposed KWP II Down-road Alternative wind-energy site, Maui, Hawaii, based on radar data collected in July 2009. Values of particular importance are in boxes.

Variable/parameter	HAPE		NESH	
	Minimum	Maximum	Minimum	Maximum
MOVEMENT RATE (MVR)				
A) Mean movement rate (targets/h)				
A1) Mean rate during nightly peak movement periods in spring/summer based on July 2009 data (targets/h)	1.776	1.776	1.776	1.776
A2) Mean rate during nightly peak movement periods in fall based on July 2009 data (targets/h)	1.776	1.776	1.776	1.776
B) Number of hours of evening and morning peak-period sampling	5	5	5	5
C) Mean number of targets during evening and morning peak-movement periods				
C1) Spring/summer (A1 * B)	8.88	8.88	8.88	8.88
C2) Fall (A2 * B)	8.88	8.88	8.88	8.88
D) Mean proportion of birds moving during off-peak h of night	0.126	0.126	0.126	0.126
E) Seasonal movement rate (targets/night) = ([C * D] + C)				
e1) Spring/summer	10.0	10.0	10.0	10.0
e2) Fall	10.0	10.0	10.0	10.0
F) Mean number of birds/target	1.05	1.05	1.05	1.05
G) Estimated proportion of each species	0.60	0.60	0.40	0.40
H) Daily movement rate (birds/day; = E * F * G)				
H1) Spring/summer	6.30	6.30	4.20	4.20
H2) Fall	6.30	6.30	4.20	4.20
I) Fatality domain (days/year)				
I1) Spring/summer	180	180	150	150
I2) Fall	75	75	60	60
J) Annual movement rate (birds/year; = ([H1 * I1] + [H2 * I2]), rounded to next whole number)	1,607	1,607	882	882
HORIZONTAL INTERACTION PROBABILITY (IPH)				
K) Turbine height (m)	100	100	100	100
L) Blade radius (m)	35.25	35.25	35.25	35.25
M) Height below blade (m)	29.5	29.5	29.5	29.5
N) Front-to-back width (m)	6	6	6	6
O) Minimal side profile area (m ² ; = K * N)	600		600	
P) Maximal front profile area (m ² ; = [M * N] + [π * L ²])		4,081		4,081
Q) Cross-sectional sampling area of radar at or below 100 m turbine height (= 3000 m * 100 m = 300,000 m ²)	300,000	300,000	300,000	300,000
R) Minimal horizontal interaction probability (= O/Q)	0.00200000		0.00200000	
S) Maximal horizontal interaction probability (= P/Q)		0.01360211		0.01360211
VERTICAL INTERACTION PROBABILITY (IPV)				
T) Proportion of petrels flying \leq turbine height)	0.51	0.51	0.51	0.51

Table 2. Continued.

Variable/parameter	HAPE		NESH	
	Minimum	Maximum	Minimum	Maximum
EXPOSURE INDEX (ER = MVR * IPH * IPV)				
U) Daily exposure index (birds/turbine/day; = H * (R or S) * T; rounded to 8 decimal places)				
U1) Spring/summer	0.00642528	0.04369870	0.00428352	0.02913247
U2) Fall	0.00642528	0.04369870	0.00428352	0.02913247
V) Annual exposure index (birds/turbine/year; = J * (R or S) * T; rounded to 8 decimal places)	1.63914000	11.14788498	0.89964000	6.11850314
FATALITY PROBABILITY (MP)				
W) Probability of striking turbine if in airspace on side approach	1.00	1.00	1.00	1.00
X) Probability of striking turbine if in airspace on frontal approach	0.20	0.20	0.20	0.20
Y) Probability of fatality if striking turbine ¹	1.00	1.00	1.00	1.00
Z1) Probability of fatality if an interaction on side approach (= W * Y)	1.00000		1.00000	
Z2) Probability of fatality if an interaction on frontal approach (= X * Y)		0.19500		0.19500
FATALITY INDEX (= ER * MP)				
Annual fatality rate with 90% exhibiting collision avoidance (birds/turbine/year; = V * (Z1 or Z2) * 0.1)	0.16391	0.21738	0.08996	0.11931
Annual fatality rate with 95% exhibiting collision avoidance (birds/turbine/year; = V * (Z1 or Z2) * 0.05)	0.08196	0.10869	0.04498	0.05966
Annual fatality rate with 99% exhibiting collision avoidance (birds/turbine/year; = V * (Z1 or Z2) * 0.01)	0.01639	0.02174	0.00900	0.01193

¹ Used 100% fatality probability due to ESA definition of “take”; however, actual probability of fatality with collision <100% (see methods).

rounding up to the nearest whole number), we estimate that 2–12 Hawaiian Petrels and 1–7 Newell’s Shearwater fly within the space occupied by each wind turbine in an average year (Tables 2 and 4) and estimate that 1 Hawaiian Petrel and 1 Newell’s Shearwater fly within the space occupied by the 65-m-high met tower in an average year (Tables 3 and 4). Note that all these calculations are exposure rates and, thus, include an unknown proportion of birds that would detect and avoid the turbines and met towers. Hence, exposure rates estimate how many times/year a petrel or shearwater would be exposed to wind turbines or met towers and not necessarily the number that actually would collide with those structures.

FATALITY MODELING

The individual steps and estimates involved in calculating fatality rates are shown in Table 2

(turbines) and Table 3 (met tower). We speculate that the proportions of birds that detect and avoid turbines and towers is substantial (see Discussion), but limited petrel- or shearwater-specific data are available to use for an estimate of the avoidance rates for those types of structures. Because it is necessary to estimate the fatality of petrels and shearwaters at the proposed project, however, we assumed that 90%, 95%, or 99% of all birds will be able to detect and avoid the towers and turbines. If we also assume that 100% of the birds colliding with a turbine/tower die (although see above), the ranges of annual fatalities are 0.016–0.217 Hawaiian Petrel/turbine/yr and 0.009–0.119 Newell’s Shearwaters/turbine/year (Table 2). For the 65-m met tower, we estimate a fatality rate of 0.008–0.081 Hawaiian Petrel/tower/yr and 0.004–0.044 Newell’s Shearwaters/tower/year (Table 3). For cumulative annual fatalities, the

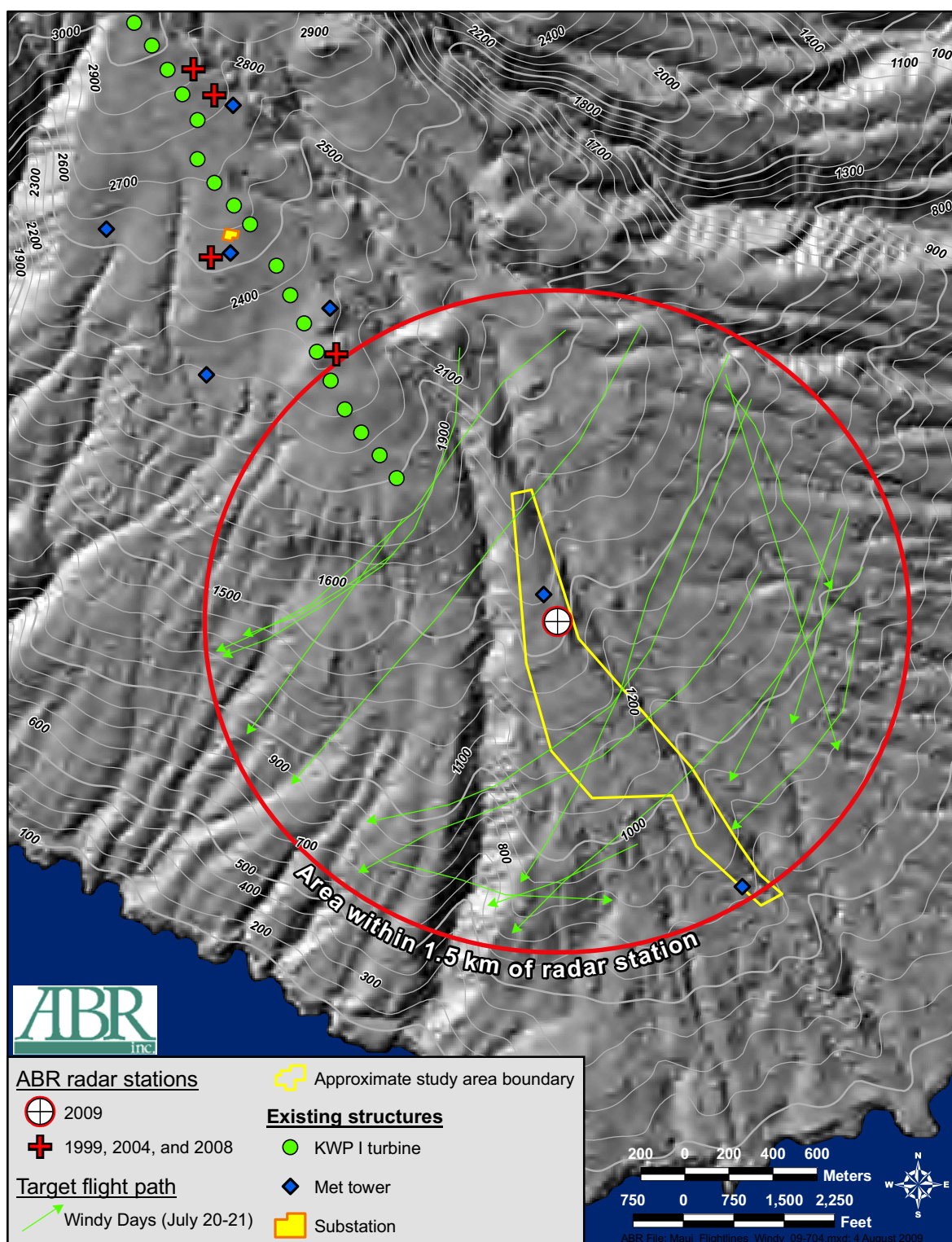


Figure 4. Location of flight paths of petrel-like radar targets observed during the strong wind conditions of 20–21 July 2009, at the KWP II Down-road Alternative wind energy facility, Maui, Hawaii.

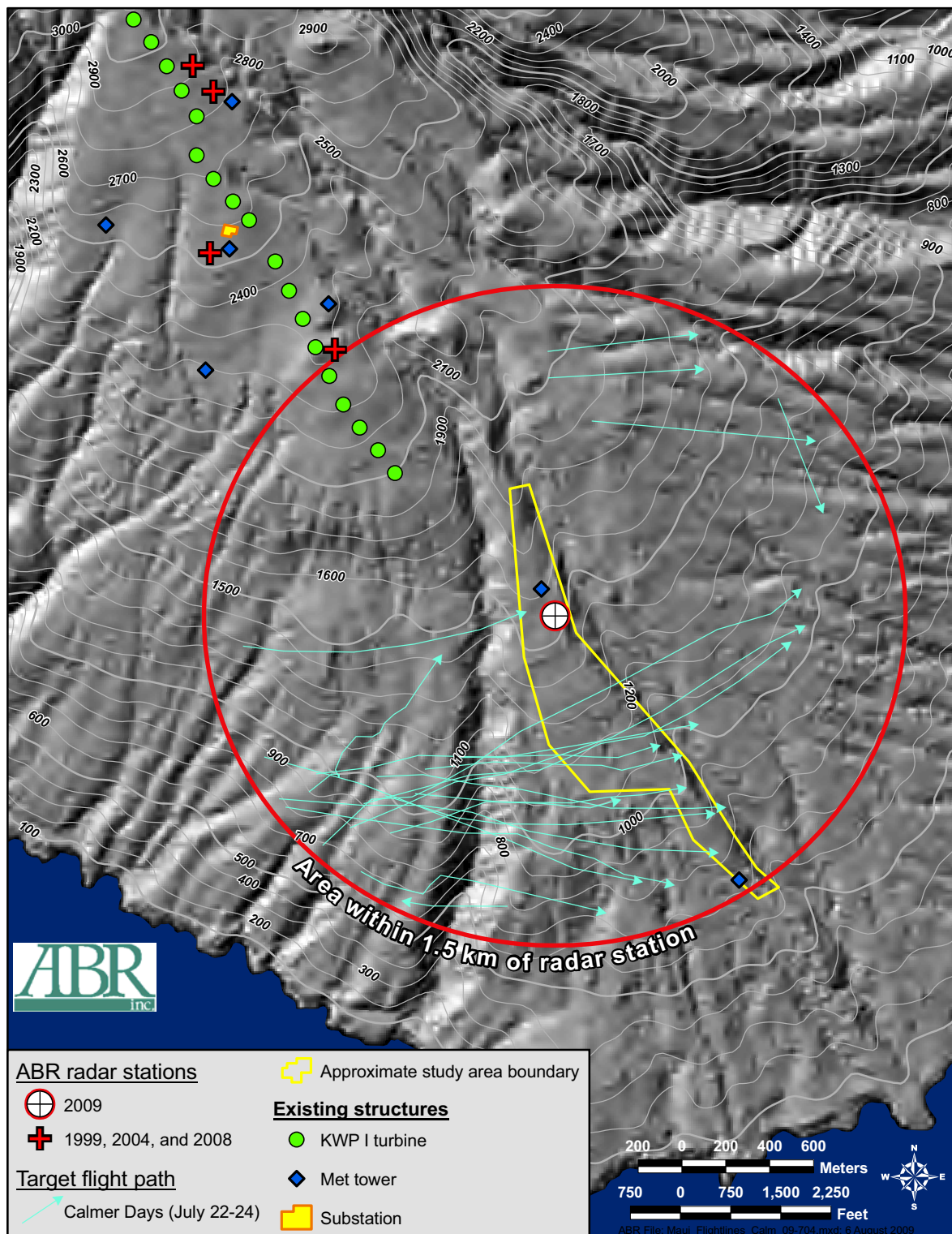


Figure 5. Location of flight paths of petrel-like radar targets observed during the light and variable wind conditions of 22–24 July 2009, at the KWP II Down-road Alternative wind energy facility, Maui, Hawaii.

Table 3. Estimated average exposure rates and fatality rates of Hawaiian Petrels (HAPE) and Newell's Shearwaters (NESH) at the proposed free-standing 65-m-tall met tower at the KWP II Down-road alternative wind-energy site, Maui, Hawaii, based on radar data collected in July 2009. Values of particular importance are in boxes.

Variable/parameter	HAPE	NESH
MOVEMENT RATE (MVR)		
A) Mean movement rate (targets/h)		
A1) Mean rate during nightly peak movement periods in spring/summer based on July 2009 data (targets/h)	1.776	1.776
A2) Mean rate during nightly peak movement periods in fall based on July 2009 data (targets/h)	1.776	1.776
B) Number of hours of evening and morning peak-period sampling	5	5
C) Mean number of targets during evening and morning peak-movement periods		
C1) Spring/summer (A1 * B)	8.88	8.88
C2) Fall (A2 * B)	8.88	8.88
D) Mean proportion of birds moving during off-peak h of night	0.126	0.126
E) Seasonal movement rate (targets/night) = ((C * D) + C)		
e1) Spring/summer	10.0	10.0
e2) Fall	10.0	10.0
F) Mean number of birds/target	1.05	1.05
G) Estimated proportion of each species	0.60	0.40
H) Daily movement rate (birds/day = E * F * G)		
h1) Spring/summer	6.30	4.20
h2) Fall	6.30	4.20
I) Fatality domain (days/year)		
i1) Spring/summer	180	150
i2) Fall	75	60
J) Annual movement rate (birds/year; = ((H1 * I1) + (H2 * I2)), rounded to next whole number)	1,607	882
HORIZONTAL INTERACTION PROBABILITY (IPH)		
K) Maximal cross-sectional area of tower (side view = 297 m ²)	297.0	297.0
L) Cross-sectional sampling area of radar at or below 50 m tower height (= 3000 m * 65 m = 195,000 m ²)	195000.000	195000.000
M) Average probability of radar target intersecting the met tower (= K/L, rounded to 8 decimal places)	0.00152308	0.00152308
VERTICAL INTERACTION PROBABILITY (IPV)		
N) Proportion of petrels flying ≤ tower height	0.33	0.33
EXPOSURE INDEX (ER = MVR * IPH * IPV)		
O) Daily exposure index (birds/tower/day = H * M * N, rounded to 8 decimal places)		
O1) Spring/summer	0.00316612	0.00211075
O2) Fall	0.00316612	0.00211075
P) Annual exposure index (birds/tower/year = J * M * N, rounded to 8 decimal places)	0.80770292	0.44330677
FATALITY PROBABILITY (MP)		
Q) Probability of striking tower if in airspace	1.00	1.00
R) Probability of fatality if striking tower ¹	1.00	1.00
S) Probability of fatality if an interaction (= Q * R)	1.00000	1.00000
FATALITY INDEX (= ER * MP)		
T) Annual fatality rate with 90% exhibiting collision avoidance (birds/tower/year = P * S * 0.1)	0.08077	0.04433
U) Annual fatality rate with 95% exhibiting collision avoidance (birds/tower/year = P * S * 0.05)	0.04039	0.02217
V) Annual fatality rate with 99% exhibiting collision avoidance (birds/tower/year = P * S * 0.01)	0.00808	0.00443

¹ Used 100% fatality probability due to ESA definition of "take", however actual probability of fatality with collision <100% (see methods).

annual fatality rate would be 0.229–3.043 Hawaiian Petrels/yr and 0.126–1.670 Newell’s Shearwaters/yr for all 14 proposed wind turbines combined (Table 4). The cumulative annual fatalities at the one proposed met tower would be 0.008–0.081 Hawaiian Petrels/yr and 0.004–0.044 Newell’s Shearwaters/yr (Table 4). We caution again, however, that the range of assumed avoidance rates of seabirds and turbines/towers (90–99%) is not fully supported by empirical data at this time.

DISCUSSION

MOVEMENT RATES AND FLIGHT BEHAVIOR

Within KWP, there has been some variation in mean movement rates among years and studies (Table 5), but all estimated rates have been low (i.e., between 0.5 and 1.8 targets/h). Thus, mean movement rates of Hawaiian Petrels recorded in the KWP study areas (i.e., ~1–2 targets/h; this study; Day and Cooper 1999, Cooper and Day 2004; Sanzenbacher and Cooper 2008, 2009) are much lower than those over the eastern and northern sides of Maui (Cooper and Day 2003).

Our limited data (i.e., five sampling nights) from the current study suggest that patterns of movement may have been affected by the wind regime. We found that shearwater/petrels mostly flew in an outbound movement towards the southwest during strong Trade Winds and flew inbound toward the east during light and variable winds (i.e., at wind speeds that apparently were below the cut-in speed of the KWP I turbines that were not spinning at the time). Our limited data also suggested that the passage rates might be higher over the lower (southern) end of the study area than elsewhere during calm conditions, though, again note that we only had two nights of sampling during strong winds and three nights during light winds. The flight directions of the targets observed during light winds suggest that they were birds approaching Maui from the west and “cutting the corner” of West Maui on their way to breeding colonies on Haleakala.

VISUAL OBSERVATIONS OF PETRELS AND SHEARWATERS

In total, we have had three visual observations of Hawaiian Petrels and two observations of unidentified shearwaters/petrels over the KWP study areas during 1999–2009 (Table 6; Day and Cooper 1999, Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009; this study). The birds observed in the evening period were headed easterly or northeasterly, and the birds observed in the morning were heading southeasterly or southwesterly. These directions fit a pattern of inbound movements toward Haleakala in the evening and outbound movements from Haleakala and/or West Maui in the morning.

Flight altitudes of the two birds that we observed over the proposed turbine-string ridges were within turbine heights (i.e., one was at 40 m agl and the other was at 65 m agl; Table 6). The flight altitudes of the other three birds were much higher (i.e., 300–500 m agl), but they were measured over the valley to the east; hence, we not know what their flight altitudes were as they flew over the ridges on which the turbine strings lie. Thus, it is possible that visual altitude data is biased to detecting lower-flying birds, the very limited data that we have for known flight altitudes ($n = 2$) suggest that a substantial proportion of petrels may have flown within the turbine-height zone.

In our fatality models, we used the timing of inland flights at the nearby Ukumehame site from Cooper and Day (2003) to correct for proportions of targets that were Hawaiian Petrels and those that were Newell’s Shearwaters; those data suggested that 60% of the targets were Hawaiian Petrels and 40% of the targets were Newell’s Shearwaters. However, the timing of two of the three Hawaiian Petrels that we saw over the site (Table 6) occurred during the late evening, a period when Cooper and Day (2003) assumed that only Newell’s Shearwaters would occur. Thus, these visual observations suggest the possibility that more than 60% of the radar targets we observed in the current study could have been Hawaiian Petrels. We do not recommend changing the relative proportions of Hawaiian Petrels vs. Newell’s Shearwaters in the fatality model, however, unless further data are collected to confirm this pattern.

Table 4. Summary of exposure rates, fatality rates, and cumulative fatality rates for Hawaiian Petrels (HAPE) and Newell's Shearwaters (NESH) at wind turbines and meteorological (met) towers at the proposed KWP II Down-road Alternative wind-energy site, Maui, Hawaii, based on radar data collected in July 2009.

Structure type	Exposure rate/structure (birds/structure/yr)		Avoidance rate	Fatality rate/structure (birds/structure/yr)		No. structures	Cumulative fatality rate (birds/yr)	
	HAPE	NESH		HAPE	NESH		HAPE	NESH
GE 1.5 MW turbine	1.639 (min)	0.900 (min)	0.90 (min)	0.164	0.090	14.00	2.295	1.259
	11.148 (max)	6.119 (max)	0.90 (max)	0.217	0.119	14.00	3.043	1.670
			0.95 (min)	0.082	0.045	14.00	1.147	0.630
			0.95 (max)	0.109	0.060	14.00	1.522	0.835
			0.99 (min)	0.016	0.009	14.00	0.229	0.126
			0.99 (max)	0.022	0.012	14.00	0.304	0.167
65-m free-standing met tower	0.808	0.443	0.90	0.081	0.044	1.00	0.081	0.044
			0.95	0.040	0.022	1.00	0.040	0.022
			0.99	0.008	0.004	1.00	0.008	0.004

Table 5. Mean (\pm SE) movement rates of petrel-like targets measured with radar at the KWP wind-energy site and proposed KWP II wind-energy sites, Maui, Hawaii, during 1999–2009 studies.

Year	Site	Movement rate (targets/h)		Source
		Summer	Fall	
1999	KWP I	1.2 ± 0.3	–	Day and Cooper (1999)
2004	KWP I	–	1.0 ± 0.2	Cooper and Day (2004)
2008	KWP II	0.46 ± 0.15	0.09 ± 0.07	Sanzenbacher and Cooper (2008, 2009)
2009	KWP II Alternate	1.78 ± 0.14	–	current study

Table 6. Records of Hawaiian Petrels and unidentified shearwaters/petrels at the proposed KWP II wind-energy site and nearby KWP I wind-energy site, Maui, Hawaii, during 1999–2009 studies.

Date	Time	Species ¹	Number	Altitude (m agl)	Flight direction
28 May 1999	2150	HAPE	1	300 ²	NE
28 May 1999	0608	UNSP	2	500 ²	SE
12 October 2004	0608	HAPE	1	500 ²	SE
15 October 2004	0454	UNSP	1	65	SW
24 July 2009	2126	HAPE	1	40	E

¹ HAPE = Hawaiian Petrel; UNSP = unidentified shearwater/petrel.

² Flight altitude measured over the valley to east of the proposed turbine string ridge, not over the proposed turbine string ridge itself; measurements were done that way because that is where birds were first seen.

EXPOSURE RATES AND FATALITY ESTIMATES

We estimated that 2–12 Hawaiian Petrels and 1–7 Newell's Shearwater would fly within the space occupied by each wind turbine in an average year and estimated that 1 Hawaiian Petrel and 1 Newell's Shearwater would fly within the space occupied by the 65-m-high met tower in an average year (Table 4). We used these estimated exposure rates as a starting point for developing a complete avian risk assessment; however, we emphasize that it currently is unknown whether bird use (i.e., exposure) and fatality at windfarm structures are strongly correlated. For example, Cooper and Day (1998) found no relationship between movement rates and fatality rates of Hawaiian Petrels and Newell's Shearwaters at powerlines on Kaua'i, indicating that other factors had a much greater

effect on causing fatality than movement rates did. For example, other factors such as proximity to the ocean or poor weather could be more highly correlated with fatality rates than is bird abundance. As an example, collisions of Laysan Albatross with a large array of communication-tower antenna wires and guy wires adjacent to large, high-density albatross breeding colonies on Midway Atoll occurred at a far higher rate during periods of high winds, rain, and poor visibility than during periods of better weather: 838 (>25%) of the 2,901 birds killed during the study were killed during two storms (Fisher 1966). To determine which factors are most relevant, future studies that collect concurrent data on movement rates, weather, and fatality rates would be useful to begin to determine whether movement rates and/or weather conditions can be used to predict the

likelihood of petrel fatalities at wind turbines and other structures across the entire proposed windfarm.

In addition, few data are available on the proportion of petrels and shearwaters that do not collide with wind turbines or met towers because of collision-avoidance behavior (i.e., birds that completely alter their flight paths horizontally and/or vertically to avoid flying through the space occupied by a turbine/tower). Clearly, the detection of wind turbines or other structures could result in collision-avoidance behavior by these birds and reduce the likelihood of collision. There also appear to be differences between petrels and shearwaters in their ability to avoid obstacles. For example, Cooper and Day (1998) indicated that Hawaiian Petrels have flight characteristics that make them more adept at avoiding powerlines than Newell's Shearwaters, suggesting that Hawaiian Petrels might also be more likely to avoid collisions with other structures such as wind turbines. These authors also suggested that the tendency for Hawaiian Petrels to approach and leave nesting colonies primarily during crepuscular periods enables these birds to see and avoid structures (e.g., wind turbines) more easily than do Newell's Shearwaters that approach and leave nesting colonies primarily during nocturnal periods.

Some collision-avoidance information is available on petrels and shearwaters from earlier work that we conducted on Kaua'i (Cooper and Day 1998; Day et al., *In review*). In summary, those data suggest that the behavioral-avoidance rate of Hawaiian Petrels and Newell's Shearwaters near powerlines is high. For example, across all 207 Hawaiian Petrels observed flying within 150 m of transmission lines on Kauai, 40 exhibited behavioral responses; of those 40 birds that exhibited collision-avoidance responses, none (0%) collided with a transmission line. Thus, the collision-avoidance rate for Hawaiian Petrels was 100% (i.e., 40 of 40 interactions). Across all 392 Newell's Shearwaters observed flying within 150 m of transmission lines, 29 exhibited behavioral responses; of those 29 birds that exhibited collision-avoidance responses, none (0%) collided with a transmission line. However, one Newell's Shearwater that did not exhibit a collision-avoidance response hit a transmission line. Thus,

the collision-avoidance rate for Newell's Shearwaters was 97% (i.e., 29 of 30 interactions).

There also is some information available on collision-avoidance of Hawaiian Petrels on Lana'i, where the behavior of petrels was studied as they approached large communication towers near the breeding colony (TetraTech 2008; Day et al., *In review*). In that study, all 20 (100%) of the Hawaiian Petrels seen on a collision-course toward communication towers exhibited avoidance behavior and avoided collision.

Additional data that provides some insight on collision-avoidance behavior of petrels and shearwaters at windfarm structures (e.g., wind turbines and met towers) are available from other studies associated with the operational KWP I wind facility. There was 1 Hawaiian Petrel fatality and 0 Newell's Shearwater fatalities observed at the 20-turbines and three met towers in the first 3.5 years of operation (G. Spencer, FirstWind, pers. comm.). Calculations using data for scavenging bias and searcher efficiency collected at the KWP I wind facility indicate that the one observed fatality equates to a corrected direct take of 0.5 Hawaiian Petrels/yr and 0 Newell's Shearwaters/yr (Kaheawa Wind Power LLC 2009, *in prep*). Cooper and Day (2004b) modeled seabird fatality for the KWP I wind turbines, based on movement rates from radar studies at the site (Day and Cooper 1999; Cooper and Day 2004a, 2004b), and estimated that the combined annual fatality of Hawaiian Petrels and Newell's Shearwaters at the KWP I turbines would be ~3–18 birds/yr with a 50% avoidance rate, ~1–2 birds/yr with a 95% avoidance rate, and <1 bird/yr with a 99% avoidance rate. Thus, the fatality model that used a 99% avoidance value was a closer fit with the measured fatality rates than was the fatality models that used a 50% or 95% avoidance rate.

In summary, currently available data from Kaua'i, Lana'i, and Maui suggest that the avoidance rate of petrels and shearwaters at transmission lines and communications towers is high and approaches 100% (Day et al., *in review*). Data from the fatality searches at turbines and met towers on Maui are more difficult to interpret because they suggest high avoidance but are not a direct measure of avoidance; however those data also suggest that avoidance of those structures must be occurring because only one Hawaiian

Petrel has been found during regular fatality searches of those structures over a 3.5-year period. Thus, the overall body of evidence, while incomplete, is consistent with the hypothesis that the average avoidance rate of wind turbines and met towers is substantial and potentially is $\geq 95\%$. The ability of Hawaiian Petrels and Newell's Shearwater to detect and avoid most objects under low-light conditions makes sense from a life-history standpoint, in that they forage extensively at night and are adept at flying through forests near their nests during low light conditions.

In addition to the limited data available for Hawaiian Petrels and Newell's Shearwaters, there is evidence that many other species of birds detect and avoid structures (e.g., wind turbines, met towers) during low-light conditions (Winkelman 1995, Dirksen et al. 1998, Desholm and Kahlert 2005, Desholm et al. 2006). For example, seaducks in Europe have been found to detect and avoid wind turbines $>95\%$ of the time (Desholm 2006). Further, natural anti-collision behavior (especially alteration of flight directions) is seen in migrating Common and King eiders (*Somateria mollissima* and *S. fischeri*) approaching human-made structures in the Beaufort Sea off of Alaska (Day et al. 2005) and in diving ducks approaching offshore windfarms in Europe (Dirksen et al. 1998). Collision-avoidance rates around wind turbines are high for Common Eiders in the daytime (Desholm and Kahlert 2005), gulls (*Larus* spp.) in the daytime ($>99\%$; Painter et al. 1999, cited in Chamberlain et al. 2006), Golden Eagles (*Aquila chrysaetos*) in the daytime ($>99\%$; Madders 2004, cited in Chamberlain et al. 2006), American Kestrels (*Falco sparverius*) in the daytime (87%, Whitfield and Band [in prep.], cited in Chamberlain et al. 2005), and passerines during both the day and night ($>99\%$; Winkelman 1992, cited in Chamberlain et al. 2006).

We agree with others (Chamberlain et al. 2006, Fox et al. 2006) that species-specific, weather-specific, and site-specific avoidance data are needed in models to estimate fatality rates accurately. However, the currently available avoidance data from Kaua'i and Lana'i for Hawaiian Petrels and Newell's Shearwaters and the petrel fatality data at KWP I wind turbines and met towers while incomplete, is consistent with the notion that a substantial proportion of petrels detect

and avoid wind turbines, marked met towers, communication towers, and powerlines under normal ranges of weather conditions and visibility (but note that avoidance rates could be lower under inclement conditions). Until further petrel- and shearwater-specific data on the relationship between exposure and fatality rates are available for structures at windfarms, we continue to provide a range of assumptions for avoidance rates in our fatality models (i.e., 90%, 95%, and 99% avoidance), along with a discussion of the body of evidence that, while incomplete at this time, is consistent with the notion that the average avoidance-rate value is substantial and potentially is $\geq 95\%$. With an assumption of a 95% avoidance rate, the estimated average annual take at the KWP II Downroad Alternative would be ≤ 0.1 Hawaiian Petrel/turbine/yr and ≤ 0.06 Newell's Shearwaters/turbine/yr and, for met towers, fatality would be 0.04 Hawaiian Petrel/tower/yr and 0.02 Newell's Shearwaters/tower/yr.

Other factors could affect our estimates of fatality in either a positive or a negative direction. One factor that would have created a positive bias was the inclusion of targets that were not petrels or shearwaters. Our visual observations of several other species with similar target characteristics to petrels (especially during crepuscular periods, when we could use binoculars) helped to minimize the inclusion of these non-target species, but it is possible (especially during nocturnal conditions) that some of our radar targets were other fast-flying species that were active during the sampling period (e.g., Pacific Golden-Plover [*Pluvialis fulva*]). A second positive bias in our fatality model is our simplistic assumption that movement rates of seabirds do not fall as individual fatalities occurred (i.e., we assumed sampling with replacement for fatalities). Given the low movement rates observed in this study, it is likely that the fatality of just a single bird would substantially reduce the average nightly movement rates. A third positive bias is the assumption that turbines are operating at maximal rotor speed; this assumption clearly is incorrect because of variability in winds, but using it results in maximal estimates of collision rates for birds flying through the turbine rotors.

There also are factors that could create a negative bias in our fatality estimates. One example would be if targets were missed because

they flew within radar shadows. Because the sampling stations provided good coverage of the surrounding area, we believe that the proportion of targets that was missed because they passed through the entire area of coverage of the study area within a radar shadow was minimal.

A factor that could affect the predictive value of our fatality estimates in either direction is interannual variation in the number of birds visiting nesting colonies on Maui. Average hourly movement rates for the current study (≈ 1.8 targets/h), from 2004 (summer ≈ 0.5 targets/h; fall ≈ 0.1 targets/h; Sanzenbacher and Cooper 2008, 2009), from summer 1999 (1.2 targets/h; Day and Cooper 1999), and from fall 2004 (1.0 targets/h; Cooper and Day 2004a) all suggest that rates are consistently low at the KWP project areas relative to other areas on Maui, and that interannual variation in that overall level of bird use of the area is minimal. Some caution in extrapolation of movement rates across years is still warranted, however, because there are examples of other sites with high interannual variation in counts, such as the three sites on Kaua'i where counts were ~ 100 – 300 birds/hr lower (\sim four times lower) in fall 1992 than in fall 1993; the lower counts in 1992 were attributed to the effects of Hurricane Iniki (Day and Cooper 1995). Oceanographic factors (e.g., El Niño–Southern Oscillation events) also vary among years and are known to affect the distribution, abundance, and reproduction of seabirds (e.g., Ainley et al. 1994, Oedekoven et al. 2001). Another factor that could cause interannual variation in counts in either direction is overall population increases or declines. For example, there was a $\sim 60\%$ decline in radar counts on Kaua'i between 1993 and 1999–2001 that was attributed to population declines of Newell's Shearwaters (Day et al. 2003b).

CONCLUSIONS

We used our risk-assessment model to estimate the number of Hawaiian Petrels and Newell's Shearwaters that might be killed by collisions with wind turbines and met towers at the proposed KWP II Down-road Alternative facility. The model is affected by several input variables, including the collision-avoidance rate. The absence behavioral studies to fully quantify avoidance rates

at wind turbines and met towers precludes determination of actual avoidance rates; however, a growing body of evidence suggests that a high percentage of petrels and shearwaters detect and avoid structures such as communication towers, transmission lines, and wind turbines (see above). We also suspect high rates of anti-collision behaviors because petrels must rely upon acute nocturnal vision for foraging and other flight activities under varying weather conditions. In conclusion, we believe that the proportion of petrels that would see and avoid proposed wind turbines at the KWP II Down-road Alternative will be high, but until studies are conducted to quantify avoidance behavior at wind turbines and met towers, we provide a range of assumptions for avoidance rates in our fatality models (i.e., 90%, 95%, and 99% avoidance rates) along with a discussion of the body of evidence that is consistent with the hypothesis that the average avoidance-rate value is substantial and potentially $\geq 95\%$. With an assumption of 95% avoidance, the estimated average annual take at the proposed KWP II Down-road Alternative wind turbines would be ≤ 0.1 Hawaiian Petrel/turbine/yr and ≤ 0.06 Newell's Shearwaters/turbine/yr. The estimated average annual take at the proposed KWP II Down-road Alternative met tower (with an assumption of 95% avoidance) would be 0.04 Hawaiian Petrel/tower/yr and 0.02 Newell's Shearwaters/tower/yr.

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Appendix 4

Wildlife Education and Observation Program

Purpose	To educate project employees and other on-site personnel in the observation, identification and treatment of wildlife
Approach	<p>In conjunction with regular assigned duties, all personnel will:</p> <ul style="list-style-type: none">⤴ attend wildlife education briefings conducted in cooperation with DOFAW and USFWS;⤴ monitor wildlife activity while on the site;⤴ identify key species when possible (Hawaiian Petrel, Newell's Shearwater, Nene and Hawaiian Hoary Bat);⤴ document specific observations with the filing of a Wildlife Observation Form;⤴ identify, report and handle any downed wildlife in accordance with the Downed Wildlife Protocol, including filing a Downed Wildlife Monitoring Form – Incidence Report;⤴ respond and treat wildlife appropriately under all circumstances.
Notes	All personnel will avoid approaching any wildlife other than downed wildlife; avoid any behavior that would startle or harass any wildlife; and not feed any wildlife.

Descriptions and Photographs
Follow

Hawaiian Petrel	
Description	16 inches, 36-inch wingspan. Head, wings and tail are sooty-colored, contrasting with slightly paler back. Forehead and underparts are white; tail is short. Feet are bi-colored pink and black. Downy chicks are charcoal gray.
Voice	Distinctive call heard at breeding colonies is a repeated moaning “ooh-ah-ooh.” At their burrows, birds also produce a variety of yaps, barks and squeals.
Habits	The Hawaiian Petrel is generally seen close to the main Hawaiian islands during breeding season; otherwise, it is a pelagic species. The flight is characterized by high, steeply-banked arcs and glides; the wings are long and narrow. Breeding extends from March to October. One white egg is laid within deep burrows or under rocks. Adults arrive in colonies well after dark. As the chicks develop, parental care becomes less frequent and adults leave the colony each year two to three weeks before the chicks. Adults feed on squid, fish and crustaceans, and pass food to chicks by regurgitation. Predation by introduced rats, cats and mongooses is a serious threat to this species.



HNP/C. Hodges



HVNP/W. Banks

source: <http://pacificislands.fws.gov/wesa/uau.html>







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source: <http://www.birdinghawaii.co.uk/xHawaiianPetrel2.htm>

Newell's Shearwater	
Description	12 – 14 inches, 30 – 35-inch wingspan. Black above and white below. The white extends from the throat to the black undertail coverts. Sharp contrast of dorsal/ventral color is more distinct than in larger, more common Wedge-tailed Shearwater. Bill, legs and toes are dark; webbing between toes is pink.
Voice	Around nesting colony, a variable, jackass-like braying and crow-like calling.
Habits	The flight of the Newell's Shearwater is characterized by rapid, stiff wingbeats and short glides. This species occurs in Hawaiian waters during the breeding season (April to November); it flies to nesting colonies only after dark, departing before dawn. Birds are highly vulnerable to predation by rats and cats. Many fledglings departing the colonies in late fall are attracted to urban lights and fall on highways or other brightly-lit areas.
<div>  <p>Painting by Sheryl Ives Boynton</p> </div> <div>  <p>source: http://audubon2.org/webapp/watchlist/viewSpecies.jsp?id=141</p> </div>	
<div>  <p>© Christian Melgar</p> </div> <div>  <p>source: http://www.birdinghawaii.co.uk/XNewells2.htm</p> </div>	

Nene	
Description	22 – 26 inches, sexes similar. A medium-sized goose with black head and nape that contrasts with yellow-buff cheek. Neck is also buffy but with dark brown furrows. Heavily barred gray-brown above; lighter barrel below. Bill and partially-webbed feet are black. Adults weigh approximately 4 pounds, males are larger.
Voice	Call is a loud “haw” or “haw-ah,” resembling honking of the Canada Goose. Also gives a variety of muted calls, often resembling the “moo” of a cow.
Habits	Nene frequent scrubland, grassland, golf courses, and sparsely-vegetated slopes and, on Kauaʻi, open lowland country. They feed on a variety of native and introduced plants. The breeding season extends from November to June. The nest is a down-lined bowl usually well-concealed under bushes; two to five white eggs are laid. Approximately 85 Nene have been released at Hanaula since 1995 as part of DOFAW’s propagation and recovery program. Predation by introduced mongooses and feral cats on eggs, goslings and brooding adults inhibits population increases.



source: <http://www.aloha-hawaii.com/hawaii/nene>



source: <http://www.50states.com/bird/nene.htm>



source:
<http://www.thewildones.org/Animals/nene.html>



source: <http://www.coffeetimes.com/nene.htm>

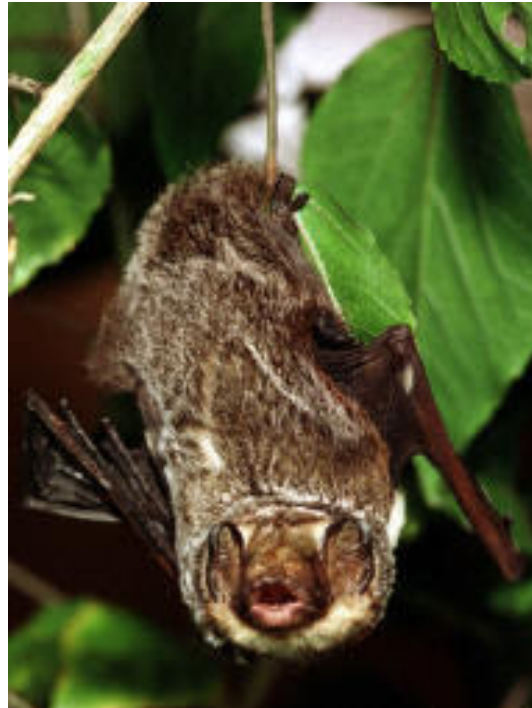
Hawaiian Hoary Bat	
Description	Weighs 5 to 8 ounces, has a 10.5 – 13.5-inch wingspan. Females are larger than males. It has a heavy fur coat that is brown and gray, and ears tinged with white, giving it a frosted or "hoary" look.
Voice	Like most insectivorous bats, this bat emits high frequency (ultrasonic) echolocation calls that detect its flying prey. These calls generally range from 15 – 30 KHz. Their lower frequency social calls may be audible to humans. These low frequency “chirps” are used to warn other bats away from their feeding territory.
Habits	<p>The Hawaiian Hoary Bat is nocturnal to crepuscular and eats insects. Little is known about its biology, distribution, or habitat use on the Hawaiian islands, though it is thought to be most abundant on the Big Island. It occurs primarily below 4,000 feet elevation, although it commonly is seen at 7,000 to 8,000 feet on Hawai`i and at 10,000 feet on Haleakala.</p> <p>On Maui, this bat is believed to primarily occur in moist, forested areas. In spite of this preference, though, it has been seen in Lahaina and near Mopua, both of which are dry, and on the dry, treeless crest of Haleakala. During the day, this bat roosts in a variety of tree species and occasionally in rock crevices and buildings; it even has been recorded hanging from wire fences on Kaua`i and has been seen leaving and entering caves and lava tubes on Hawai`i.</p>



@Jack Jeffrey

source:

<http://pacificislands.fws.gov/wesa/hrybatindex.html>



source:

http://www.honolulu zoo.org/hawaiian_bat.htm

SAMPLE

**Wildlife Education and Observation Program
KWP II
Observation Form**

Observer's Name:			Date:	
Temperature:	Wind Direction:	Wind Speed:	Precipitation:	Cloud Cover:

Species Observed	
Location	
<i>Proximity to Turbine</i>	
<i>Approximate Altitude</i>	
<i>Direction Traveling</i>	
Other Species in Area	
Comments	

Appendix 5

Life History Information on

Newell's Shearwater (*Puffinus auricularis newelli*),
Hawaiian Petrel (*Pterodroma sandwichensis*),
Hawaiian Goose (*Branta sandvicensis*)
and
Hawaiian Hoary Bat (*Lasiurus cinereus semotus*)

Compiled by:
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Honolulu, HI 96813

1.0 INTRODUCTION

Demographic factors were used to assess indirect take and loss of productivity in section 5.0 (Potential Impacts) and 6.0 (Mitigation) of the HCP. Indirect take and loss of productivity are defined as follows:

Indirect Take - These are individuals that suffer mortality as the result of a direct take of another individual. For example, the loss of a parent may also result in the loss of eggs or young.

Loss of Productivity - Productivity can be assessed in terms of chicks or fledglings produced per breeding adult per year or the number of fledglings that survive to adulthood per breeding adult per year. When a direct take occurs, loss of productivity can occur between the time the direct take occurs and the time that mitigation is provided. Productivity may also be lost if a juvenile is used as a replacement for the take of a breeding age adult. Factors that need to be taken into consideration when accounting for loss of productivity include demographic factors such as the age and sex of the individuals taken, the time of year the take occurs, and the type of mitigation provided.

Demographic factors for each species covered by the HCP were determined using existing literature. Preference was given to life history information available from Hawai'i, followed by information available for the same species on the North American continent or other areas of the world. If specific information was lacking for any species, life history information for a closely related species was used as a surrogate.

The life history information for the Newell's shearwater (*Puffinus auricularis newelli*), Hawaiian petrel (*Pterodroma sandwichensis*), Hawaiian goose (*Branta sandvicensis*) and Hawaiian hoary bat (*Lasiurus cinereus semotus*) follow in the sections below.

1.1 Seabirds

1.1.1 Newell's Shearwater

The following demographic factors and assumptions (from Ainley et al. 1997 and as otherwise noted) were used to assess indirect take and loss of productivity of the Newell's shearwater.

Breeding season: The breeding season lasts from June to October each year.

Age at First Breeding: Assumed age 6.

Adults Breeding/Year: On the basis of estimates made by Telfer (1986), incidence of non-breeding is high for Newell's Shearwater on Kaua'i. Only 46% of pairs that actively use a burrow actually breed in a given year (range 30–62 %, $n = 5$ yr, 36– 47 burrows monitored/yr).

Reproductive Success: $66.0\% \pm 6.4$ SD (range 49–75) of nests in which eggs are laid fledge young. Manx Shearwater populations have similar fledging rates (Brooke 1990). For the purposes of the HCP, a 70% average fledging rate is assumed.

Survival: Annual adult survivorship of Newell's Shearwater was estimated to be 0.904 ± 0.017 SE, on the basis of allometric equation relating survivorship to body mass in procellariiforms. This figure approximates that estimated for Manx Shearwater by more conventional means (Brooke 1990). For the purposes of the HCP, it is assumed that 50% of fledged young survive to breeding age.

Number of Broods: One per year.

Clutch Size: One.

Relative Productivity of Males vs. Females: Relative productivity of males and females is assumed to be similar, as with the Hawaiian petrel described below. For the purposes of estimating lost productivity and indirect take, it is assumed that males and females each contribute 50% towards indirect take and the average annual productivity.

1.1.2 Hawaiian Petrel

The following demographic factors and assumptions (from Simons and Hodges 1998 and as otherwise noted) were used to assess indirect take and loss of productivity of the Hawaiian petrel:

Breeding season: The breeding season lasts from May to October each year

Age at First Breeding: Unknown, but population data suggests breeding starts at age 5-6. Age 5 is assumed for purposes of estimating indirect take and lost productivity.

Adults Breeding/Year: Estimated at 89%.

Reproductive Success: Estimates of annual reproductive success (chicks fledged/eggs laid) at Haleakala, Maui from 1979–1981 (Simons 1985) and 1993 (Hodges 1994) averaged 63.4 % \pm 16.0 SD (range 38–82, $n = 128$). For the purpose of the HCP, the average annual reproductive success of 70% is assumed.

Survival: In an analysis of life history by Simons (1984), survival to breeding age was estimated to be 27%. For the purpose of the HCP, it is assumed that 30% of fledged young survive to breeding age. Yearly adult survivorship was estimated to be 93%.

Number of Broods: One per year.

Clutch Size: One.

Relative Productivity of Males vs. Females: Breeding Hawaiian petrels are apparently monogamous and show a high degree of mate fidelity over subsequent years. Pairs may exhibit courtship behavior that may last one or more seasons prior to breeding. Thus the loss of a male could cause a breeding hiatus for a female even if in pre-breeding condition. Both males and females incubate eggs and provide food for nestlings. For the purposes of estimating lost productivity and indirect take, it is assumed that males and females each contribute 50% towards indirect take and the average annual productivity.

Sex Ratio: Similar adult male and female survival rates in related species (Warham 1996) suggests a balanced sex ratio, but no published data is available.

1.2 Hawaiian Goose, Nēnē

Adjustments to the take of Nene were developed based on the following demographic factors and assumptions (from Banko et al. 1999 and USFWS 2004 and as otherwise noted):

Breeding season: The nēnē has an extended breeding season with eggs reported from all months except May, June, and July, although the majority of birds in the wild nest during the rainy (winter) season between October and March.

Age at First Breeding: Female nēnē mature at age three and males at age two. For the purposes of this HCP, it is assumed that both genders of nēnē mature at age three.

Adults Breeding/Year: Estimated at 60%.

Clutch Size: A clutch typically contains 3 to 5 eggs (mean 3.13 ± 1.07 , range 1 to 6, $n = 552$ nests in the wild)

Number of Broods: One per year.

Reproductive Success: During 4 seasons (1978–1981) mostly in highland habitat on Hawai'i and Maui, eggs hatched in at least 36 % ($n=50$) of 140 observed breeding attempts, and goslings fledged in 7 % ($n=10$; Banko 1992). During 1994– 1996 at Hawai'i Volcanoes National Park, eggs hatched in 58 % (21) of 36 nests with known outcomes, resulting in 42 goslings (2.0 goslings/successful pair) and 6 fledglings (0.29 fledgling/successful pair; Hu 1998). For the purposes of this HCP, it is assumed that adults have an average of 0.3 fledglings per pair.

Survival to breeding age: The mortality rate of captive-reared released goslings to Year 1 was reported to be 16.8% for females and 3% for males. For the purposes of this HCP, a conservative annual mortality rate of 20% is assumed for both genders of geese and this rate is assumed constant through maturity (age three).

Relative Productivity of Males vs. Females: Nēnē are highly territorial during the breeding season and males are likely to be defending nesting territories while the females are incubating. Family groups often forage together. For the purposes of estimating lost productivity and indirect take, it is assumed that males and females each contribute 50% towards indirect take and the average annual productivity.

1.3 Hawaiian Hoary Bat

Little life history information exists for the hoary bat (*Lasiurus cinereus cinereus*) found on continental America. Because these bats are migratory, do not hibernate and are not colonial, they are difficult to study. Even less life history information is available for the Hawaiian hoary bat. Hence, adjustments to the take of the Hawaiian hoary bat to account for lost productivity were developed based on the following demographic factors and assumptions using information from the hoary bat from continental America or other bat species when necessary:

Breeding Season: The pregnancy and lactating period for the female Hawaiian hoary bat occurs from April to August each year. The breeding lasts approximately four months, with a three month gestation period followed by parental care of one month (NatureServe 2008).

Age at First Breeding: Hoary bats on the continental US breed at age one (Gannon 2003, Koehler and Barclay 2000)

Adults Breeding/Year: Estimated at 100% for colonial bats (Gannon 2003), no data available for the hoary bat. Adults breeding/year is assumed to be 100 % for the Hawaiian hoary bat for purposes of this HCP.

Reproductive Success: A study following young of the hoary bat in Manitoba, Canada records that 23 out of 25 young fledged, resulting in a reproductive success of 92% (Koehler and Barclay 2000). Reproductive success is typically high for bats as they have a life history strategy where they have few young, low reproductive rates and are long lived compared to mammals of equivalent size (Kunz et al. 2005).

Survival to breeding age: No data exists for the Hawaiian hoary bat or the hoary bat on the American continent. However, survival is low for female little brown bats (*Myotis lucifugus* 20.4-47.2%) and female big brown bats (*Eptesicus fuscus*, 10.5-31.9%, Humphrey 1982). Survival rates of Hawaiian hoary bats probably approximate those of the big brown bat more closely than the little brown bat, given that they similar life history strategies such foliage

roosting and the ability to commonly have two young at a time. The survival rate of Hawaiian hoary bats is estimated to be 30%.

Number of Broods: One per year.

Litter Size: Both Bogan (1972) and Koehler and Barclay (2000) in separate observations record that 6 females located before parturition gave birth to a total of 11 young, resulting in an average litter size of 1.83.

Relative Productivity of Males vs. Females: Male hoary bats only contribute sperm to the breeding process. Females are solely responsible caring and feeding the young till fledging. For the purposes of estimating indirect take, it is assumed that males contribute nothing to indirect take and females 100%.

Sex Ratio: Sex ratios of Hawaiian hoary bats inferred from samples obtained during different seasons indicate that during the pre-pregnancy and breeding season (April to August), sex ratios in the lowlands are approximately 1:1. During the post-lactation period (September to December) the sex ratio of females to males in the lowlands increases to 4:1 (Menard 2001).

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Appendix 6

Funding Matrix
Kaheawa Wind Power II Habitat Conservation Plan

	Item/Activity	One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
General Measures	Preconstruction surveys for nene and nests	\$5,000				\$5,000
	Daily search and documentation of nene and nests during construction	\$25,000				\$25,000
	Invasive species avoidance and minimization	\$30,000	\$5,000	\$50,000	\$15,000	\$95,000
	Wildlife Education and Observation Program (WEOP)		\$1,500	\$7,500	\$25,000	\$32,500
	Hawaiian short-eared owl mitigation	\$25,000				\$25,000
	Sub-Total	\$85,000	\$6,500	\$57,500	\$40,000	\$182,500
Minimization (Higher Rates of Take)	Radar studies to characterize seabird interactions at facility			\$50,000		\$50,000
	Increased site-specific bat studies using enhanced audio-visual technologies to characterize activity levels and document bat interactions at facility		\$10,000	\$50,000	\$50,000	\$100,000
	Sub-Total		\$10,000	\$100,000	\$50,000	\$150,000

	Item/Activity	One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
Seabird mitigation (Baseline)	Alt. 1 - Makamakaole fencing and social attraction option, KWPII portion		\$80,000	\$400,000	\$150,000	\$550,000
	Alternative 2a - management and monitoring of existing fenced burrows at HNP (assuming Hawaiian petrel mitigation on Maui and supplementing an island-wide HCP for Newell's shearwater on Kauai)	\$140,000	\$30,000	\$150,000	\$120,000	\$410,000
	Alternative 2b - management and monitoring of existing fenced burrows at HNP (assuming worst case of Hawaiian petrel mitigation on Maui and participating in Newell's shearwater management project on Kauai)		\$60,000	\$300,000	\$300,000	\$600,000
	Maximum Cost		\$60,000	\$300,000	\$300,000	\$600,000
Additional Measures for Higher rates of take	Increased mitigation efforts at the same site or mitigation at another seabird site		\$30,000	\$150,000	\$100,000	\$250,000
	Sub-Total		\$30,000	\$150,000	\$100,000	\$250,000
Lower rates of Take	Same as Baseline					
Seabird Contingency Fund	Sub-Total	\$160,000				\$262,179

	Item/Activity	One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
Nene Mitigation (Baseline)						
Baseline (Preferred) Alternative 1	Captive propagation and release of goslings		\$44,000	\$176,000		\$176,000
	Staffing for on-site monitoring		\$5,000	\$25,000	\$60,000	\$85,000
	Helicopter transport of nene to release site		\$2,000	\$8,000		\$8,000
	Sub-Total		\$51,000	\$209,000	\$60,000	\$269,000
Baseline Alternative 2	Develop a nene management plan at Hanau'la and Kaheawa Pastures sites	\$5,000				\$5,000
	Funding for predator control and population monitoring at Hanau'la and Kaheawa Pastures sites		\$33,000	\$165,000	\$99,000	\$264,000
	Habitat improvement measures if required		\$10,000	\$50,000	\$50,000	\$100,000
	Creation of Safe Harbor Agreement	\$15,000				\$15,000
	Sub-Total	\$20,000	\$43,000	\$215,000	\$149,000	\$384,000
	Systematic observations of nene at the KWP II site	\$10,000				\$10,000
Additional Measures for Baseline	Sub-Total	\$10,000				\$10,000
Measures at Higher levels of Take	Release of additional 17 goslings		\$75,000	\$75,000		\$75,000
	Staffing for on-site monitoring		\$20,000		\$40,000	\$40,000
	Helicopter transport of nene to release site		\$2,000	\$4,000		\$4,000
	Sub-Total		\$97,000	\$79,000	\$40,000	\$119,000

	Item/Activity	One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
Alternative 2	Habitat improvements at Hanaula and Kaheawa Pastures		\$15,000	\$75,000	\$45,000	\$120,000
	Funding for population monitoring		\$15,000	\$75,000	\$45,000	\$120,000
	Sub-Total		\$30,000	\$150,000	\$90,000	\$240,000
Lower rates of take	same as baseline					
Additional Measures if Hanaula population declines or reintroduction efforts fail						
	New release pen if required	\$60,000				\$60,000
	Partial purchase of truck	\$10,000				\$10,000
	Staffing for on-site monitoring		\$20,000	\$80,000		\$80,000
	Helicopter transport of nene to release site		\$2,000	\$6,000		\$6,000
	Release of goslings		\$75,000	\$225,000		\$225,000
	Sub-Total	\$70,000	\$97,000	\$311,000		\$381,000
Nene Contingency Fund	Sub-Total	\$100,000				\$163,862

	Item/Activity	One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
Bat mitigation (Baseline)	Funding for management	\$150,000				\$150,000
	Bat monitoring at KWP II and vicinity for 5 years		\$12,500	\$25,000	\$37,500	\$62,500
	Sub-Total	\$150,000	\$12,500	\$25,000	\$37,500	\$212,500
Measures for Higher rates of take	Funding for increased management	\$75,000				\$75,000
	Low wind curtailment		\$15,000		\$225,000	\$225,000
	Increased site-specific bat studies using enhanced audio-visual technologies to characterize activity levels and document bat interactions at facility	\$50,000	\$10,000		\$50,000	\$100,000
	Sub-Total	\$125,000	\$25,000		\$275,000	\$400,000
Measures for Lower Rates of Take	Same as Baseline					
Bat Contingency Fund		\$75,000				\$122,896
Downed Wildlife Monitoring	Downed wildlife searches by trained technicians		\$60,000.0	\$165,000.0	\$285,000.0	\$450,000.0
	Searcher Efficiency Trials		\$10,000	\$20,000	\$15,000	\$35,000.0
	Scavenger Removal Trials		\$20,000	\$40,000	\$15,000	\$55,000.0
	Sub-Total		\$90,000	\$225,000	\$315,000	\$540,000
Reporting						
	Annual		\$7,500	\$37,500	\$112,500	\$150,000
	Semi-Annual		\$3,000	\$15,000	\$45,000	\$60,000
	Interim		\$2,500	\$12,500	\$37,500	\$50,000
	Sub-Total		\$13,000	\$65,000	\$195,000	\$260,000
State Compliance Monitoring	Sub-Total		\$20,000	\$75,000	\$225,000	\$300,000
3rd Party Monitoring Contingency	Sub-Total		\$90,000	\$225,000	\$315,000	\$540,000

	Item/Activity	One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
Estimated Project Sub-Totals						
		One-Time Cost	Annual Cost	Years 1-5	Remaining 15 Years	20-Year Permit Duration
Baseline						
	Minimization and General Measures	\$85,000	\$6,500	\$57,500	\$40,000	\$182,500
	Seabird Mitigation (Maximum)		\$60,000	\$300,000	\$300,000	\$600,000
	Nene Mitigation (Maximum)	\$30,000	\$43,000	\$215,000	\$149,000	\$394,000
	Hawaiian Hoary Bat	\$150,000	\$12,500	\$25,000	\$37,500	\$212,500
	Sub-Total	\$265,000	\$122,000	\$597,500	\$526,500	\$1,389,000
Higher						
	Minimization		\$10,000	\$100,000	\$50,000	\$150,000
	Seabird Mitigation		\$30,000	\$150,000	\$100,000	\$250,000
	Nene Mitigation (Maximum)		\$97,000	\$79,000	\$40,000	\$119,000
	Hawaiian Hoary Bat	\$125,000	\$25,000		\$275,000	\$400,000
	Sub-Total	\$125,000	\$162,000	\$329,000	\$465,000	\$919,000
Contingency Measures						
	Contingency Measures if Hanaula Nene Population exhibits failure	\$70,000	\$97,000	\$311,000		\$381,000
	3rd Party Monitoring Contingency		\$90,000	\$225,000	\$315,000	\$540,000
	Sub-Total	\$70,000	\$187,000	\$536,000	\$315,000	\$921,000
Other						
	Downed Wildlife Monitoring		\$90,000	\$225,000	\$315,000	\$540,000
	Reporting		\$13,000	\$65,000	\$195,000	\$260,000
	State Compliance Monitoring		\$20,000	\$75,000	\$225,000	\$300,000
	Sub-Total		\$123,000	\$365,000	\$735,000	\$1,100,000
Contingency Funds						
	Seabird Contingency Fund	\$160,000				\$262,179
	Nene Contingency Fund	\$100,000				\$163,862
	Hawaiian Hoary Bat Contingency Fund	\$75,000				\$122,896
	Sub-Total	\$335,000				\$548,937

Grand Total Including Maximum Cost for Baseline Mitigation	\$2,489,000
Grand Total Baseline + Contingency Measures	\$3,410,000
Grand Total for Baseline + Higher Take Level of Mitigation + Contingency Measures	\$4,329,000
Grand Total for Baseline + Higher Take Level of Mitigation + Contingency Measures + 3 Fully Escalated (Year 20) Mitigation Contingencies	\$4,877,937

Appendix 7

BOTANICAL RESOURCES SURVEY
for the
KAHEAWA PASTURES ENERGY PROJECT
UKUMEHAME, MAUI, HAWAII

by

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August 2009

Prepared for:
First Wind Energy, LLC

BOTANICAL RESOURCES SURVEY

Kaheawa Pastures Wind Energy Project

INTRODUCTION

The Kaheawa Pastures Wind Energy Project area lies on lower Kealahou Ridge on the southern tip of West Maui between Manawainui Gulch on the west and Malalawaia'ole Gulch on the east. The project area is approximately 276 acres in size TMK (2) 3-6-01:14 (por.). This study has been initiated by First Wind Energy LLC to assess the botanical resources in the area in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

Kealahou Ridge is a very evenly sloping ridge descending from Hanalei Peak to the sea at a 16% grade. Vegetation is mostly open windblown grasslands with scattered shrubs and trees in gullies. Soils are exclusively characterized as Rocklands (rRK) by the National Resource Conservation Service (Foote et al, 1972). This substrate consists of thin soils formed from gray trachyte lavas of the Honolulu Series which overlay the foundational lavas of the West Maui volcano. These lavas weather to platy gray blocks that extend across the entire ridge. This area is quite arid with annual rainfall totaling only about 12 to 20 inches per year (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this part of the mountain slope was entirely covered with native vegetation of low stature with dry grass and shrub lands and with a few trees in the gullies. The Hawaiians made some uses of forest resources here and had a cross-island trail cresting the ridge at 1600 ft. elevation. This trail was upgraded during the mid-1800s and used as a horse trail to Lahaina. It was resurrected to use in recent years and is the present Lahaina Pali Trail.

Cattle ranching began in the late 1800s and continued for over 100 years. During this time the grazing animals consumed most of the native vegetation which was gradually replaced by hardy weed species.

During the 1950s high voltage power lines were installed across the mountain along with access roads through this area. Increased traffic brought more disturbances and weeds. Fires became more frequent, further eliminating remnant native vegetation.

With the cessation of cattle grazing a number of grass and weed species have proliferated, creating a heightened fire hazard. Large fires have swept across the mountain consuming thousands of acres including the entire project area several times.

DESCRIPTION OF THE VEGETATION

The vegetation within the project area is a diverse array of grasses and low shrubs with a scattering of small trees in gullies. The most abundant species is buffelgrass (*Cenchrus ciliaris*) which has proliferated following the fires. Also common are Natal redtop (*Melinis repens*), 'ilima (*Sida fallax*), 'uhaloa (*Waltheria indica*), lesser snapdragon (*Antirrhinum orontium*) and Jamaica vervain (*Stachytarpheta jamaicensis*). A total of 62 species were recorded during the survey.

Fifteen species of native plants were found on the project area: kumuniu (*Doryopteris decipiens*), (*Cyperus phleoides* var *phleoides*) no common name, kalamalö (*Eragrostis deflexa*), 'äheahea (*Chenopodium oahuense*), nehe (*Lipochaeta lobata* var. *lobata*), nehe (*Melanthera lamarum*), puakala (*Argemone glauca*), 'akia (*Wikstroemia oahuensis*), pili grass (*Heteropogon contortus*), koali awahia (*Ipomoea indica*), 'ilima, 'uhaloa, naio (*Myoporum sandwicense*), 'ulei (*Osteomeles anthyllidifolia*) and 'a'ali'i (*Dodonaea viscosa*). The remaining 47 plant species were non-native grasses, shrubs and trees.

SURVEY OBJECTIVES

This report summarizes the findings of a botanical survey of the Kaheawa Pastures Wind Energy Project which was conducted in August, 2009.

The objectives of the survey were to:

1. Document what plant species occur on the property or may likely occur in the existing habitat.
2. Document the status and abundance of each species.
3. Determine the presence or likely occurrence of any native plant species, particularly any that are federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora in this part of the island.
5. Note which aspects of the proposed development pose significant concerns for plants and recommend measures that would mitigate or avoid these problems.

SURVEY METHODS

The entire project area was surveyed on foot. Areas on rocky gully slopes and the steep cliffs at the edges of the two large bordering gulches were examined more intensively as these were the places where the most native plants survived both the grazing of cattle and the effects of wildfires. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of the ferns are in accordance with Palmer (2003) and the flowering plants are in accordance with Wagner et al. (1999) and Staples and Herbst (2005).

For each species, the following information is provided:

1. Scientific name with author citation
2. Common English or Hawaiian name.
3. Bio-geographical status. The following symbols are used:

endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.

indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

Polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.

non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:

abundant = forming a major part of the vegetation within the project area.

common = widely scattered throughout the area or locally abundant within a portion of it.

uncommon = scattered sparsely throughout the area or occurring in a few small patches.

rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
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FERNS

NEPHROLEPIDACEAE (Sword Fern Family)

<i>Nephrolepis brownii</i> (Desv.) Hovencamp & Miyam.	Asian sword fern	non-native	rare
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PTERIDACEAE (Brake Fern Family)

<i>Doryopteris decipiens</i> (Hook.) J.Sm.	kumuniu	endemic	rare
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<i>Pityrogramma austroamericana</i> Domin	gold fern	non-native	rare
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MONOCOTS

CYPERACEAE (Sedge Family)

<i>Cyperus phleoides</i> Nees ex Kunth subsp. <i>phleoides</i>	-----	endemic	rare
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POACEAE (Grass Family)

<i>Andropogon virginicus</i> L.	broomsedge	non-native	rare
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<i>Cenchrus ciliaris</i> L.	buffelgrass	non-native	abundant
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<i>Cynodon dactylon</i> (L.) Pers.	Bermuda grass	non-native	rare
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<i>Eragrostis deflexa</i> Hitchc.	kalamalö	endemic	rare
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<i>Heteropogon contortus</i> (L.) P. Beauv. ex Roem & Schult.	pili grass	indigenous	uncommon
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<i>Melinis minutiflora</i> P. Beauv.	molasses grass	non-native	rare
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<i>Melinis repens</i> (Willd.) Zizka	Natal red-top	non-native	common
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<i>Panicum maximum</i> Jacq.	Guinea grass	non-native	rare
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<i>Sporobolus africanus</i> (Poir.) Robyns & Tournay	smutgrass	non-native	rare
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DICOTS

AMARANTHACEAE (Amaranth Family)

<i>Amaranthus spinosus</i> L.	spiny amaranth	non-native	rare
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<i>Amaranthus viridis</i> L.	slender amaranth	non-native	rare
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<i>Atriplex semibaccata</i> R. Br.	Australian saltbush	non-native	rare
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<i>Chenopodium murale</i> L.	'äheahea	non-native	rare
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SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
<i>Chenopodium oahuense</i> (Meyen) Aellen	'āheahea	endemic	rare
APOCYNACEAE (Dogbane Family)			
<i>Calotropis procera</i> (Aiton) W.T. Aiton	small crown flower	non-native	rare
ASTERACEAE (Sunflower Family)			
<i>Conyza bonariensis</i> (L.) Cronq.	hairy horseweed	non-native	uncommon
<i>Emilia fosbergii</i> Nicolson	red pualele	non-native	uncommon
<i>Lactuca sativa</i> L.	prickly lettuce	non-native	rare
<i>Lipochaeta lobata</i> (Gaud.) DC. var. <i>lobata</i>	nehe	endemic	rare
<i>Melanthera lavarum</i> (Gaud.) Wagner & Rob.	nehe	endemic	uncommon
<i>Senecio madagascariensis</i> Poir.	fireweed	non-native	rare
<i>Sonchus oleraceus</i> L.	pualele	non-native	rare
<i>Tridax procumbens</i> L.	coat buttons	non-native	uncommon
<i>Xanthium strumarium</i> L.	kikania	non-native	rare
<i>Zinnia peruviana</i> L.	zinnia	non-native	rare
BRASSICACEAE (Mustard Family)			
<i>Sisymbrium altissimum</i> L.	tumble mustard	non-native	uncommon
CACTACEAE (Cactus Family)			
<i>Opuntia ficus-indica</i> (L.) Mill.	panini	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
<i>Ipomoea indica</i> (J. Burm.) Merr.	koali awahia	indigenous	rare
EUPHORBIACEAE (Spurge Family)			
<i>Chamaesyce hirta</i> (L.) Millsp.	hairy spurge	non-native	rare
FABACEAE (Pea Family)			
<i>Acacia farnesiana</i> (L.) Willd.	klu	non-native	rare
<i>Chamaecrista nictitans</i> (L.) Moench	partridge pea	non-native	uncommon
<i>Crotalaria incana</i> L.	fuzzy rattlepod	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
<i>Desmanthus pernambucanus</i> (L.) Thellung	slender mimosa	non-native	uncommon
<i>Desmodium incanum</i> DC.	kaimi clover	non-native	rare
<i>Desmodium tortuosum</i> (Sw.) DC.	Florida beggarweed	non-native	rare
<i>Indigofera suffruticosa</i> Mill.	'inikö	non-native	uncommon
<i>Leucaena leucocephala</i> (Lam.) de Wit	koa haole	non-native	uncommon
<i>Macroptilium lathryroides</i> (L.) Urb.	wild bean	non-native	uncommon
<i>Pithecellobium dulce</i> (Roxb.) Benth.	'opiuma	non-native	rare
<i>Prosopis pallida</i> (Humb. & Bonpl. ex Willd.) Kunth	kiawe	non-native	uncommon
GENTIANACEAE (Gentian Family)			
<i>Centaurium erythraea</i> Raf.	bitter herb	non-native	rare
LAMIACEAE (Mint Family)			
<i>Leonotis nepetifolia</i> (L.) R. Br.	lion's ear	non-native	rare
MALVACEAE (Mallow Family)			
<i>Abutilon incanum</i> (Link) Sweet	hoary abutilon	non-native	rare
<i>Sida fallax</i> Walp.	'ilima	indigenous	common
<i>Waltheria indica</i> L.	'uhaloa	indigenous	common
MYOPORACEAE (Myoporum Family)			
<i>Myoporum sandwicense</i> A. Gray	naio	indigenous	rare
PAPAVERACEAE (Poppy Family)			
<i>Argemone glauca</i> (Nutt. ex Prain) Pope	puakala	endemic	rare
PLANTAGINACEAE (Plantain Family)			
<i>Antirrhinum orontium</i> L.	lesser snapdragon	non-native	common
<i>Plantago lanceolata</i> L.	narrow-leaved plantain	non-native	uncommon
PORTULACACEAE (Purslane Family)			
<i>Portulaca oleracea</i> L.	pigweed	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
<i>Portulaca pilosa</i> L.	-----	non-native	rare
PROTEACEAE (Protea Family)			
<i>Grevillea robusta</i> A. Cunn. ex R. Br.	silk oak	non-native	rare
ROSACEAE (Rose Family)			
<i>Osteomeles anthyllidifolia</i>	ūlei	indigenous	uncommon
SAPINDACEAE (Soapberry Family)			
<i>Dodonaea viscosa</i> Jacq.	'a'ali'i	indigenous	uncommon
SOLANACEAE (Nightshade Family)			
<i>Solanum lycopersicum</i> L.	cherry tomato	non-native	rare
THYMELAEACEAE ('Akia Family)			
<i>Wikstroemia oahuensis</i> (A. Gray) Rock	'akia	endemic	rare
VERBENACEAE (Verbena Family)			
<i>Lantana camara</i> L.	lantana	non-native	uncommon
<i>Stachytarpheta jamaicensis</i> (L.) Vahl.	Jamaica vervain	non-native	common

DISCUSSION

The construction of additional wind turbines will require the development of additional access roads and the clearing and leveling of construction pads within the 276 acre project area. This will result in the loss of vegetation where these occur. The area in general has experienced a dramatic loss of native plant communities over the last century and there is concern that further losses of rare species and special habitats be avoided. The proposed project was analyzed with these concerns in mind.

Of the 15 native plant species identified on the property none were found to be federally listed as Threatened or Endangered species (USFWS, 2009), nor were any found that are candidates for such status. All but two are widespread and fairly common in Hawaii. (*Lipocheata lobata*) has one Endangered variety from Oahu and one commoner variety (*L.I. var lobata*) known from Niihau, O'ahu and West Maui. The one found in the project area is the commoner variety that has no federal status. (*Eragrostis deflexa*) is a native grass that was presumed to be extinct in the early 1990s. Recent collections, some quite extensive, from West Maui, Lana'i and Kaho'olawe, however, have been identified as (*Eragrostis deflexa*) and this species is not likely to be listed as Endangered. Six populations of this grass were found within the project area along the rocky edges of the two large gulches.

Of the 15 native plant species found in the project area were most prevalent in the rocky habitat bordering Manawainui and Malalowaia'ole Gulches. This is due to the fact that these area were less accessible to grazing cattle over the years, and to the fact that these rather barren, rocky area are less susceptible to the effects of fires. The three hardiest native species 'ilima, 'uhaloa and 'a'ali'i that are more prevalent on the flatter grassy ridge tops, are the most likely to be impacted by road construction and the leveling of tower pads. These are three of the commonest native dryland plants in all of Hawaii.

It is likely that periodic fires will continue to be a problem into the foreseeable future. The area has been nearly completely overtaken by buffelgrass, a highly flammable, fire-adapted species that is quick to recover following wildfires. Meanwhile, each fire destroys more and more of even the hardiest native plants. Unless land management practices change dramatically across this dry mountain slope, little improvement in this prognosis is likely.

Previous botanical surveys on this southern tip for West Maui have identified a few Endangered species growing in gulches about two miles upslope of this project area. This area is remote from these populations and is in a habitat completely unsuitable for their growth and survival. This project is not expected to negatively impact any of these species.

Due to the general condition of the habitat and the specific lack of any environmentally sensitive native plant species or habitats on or near the project area, the proposed development work is not expected to result in any significant negative impact on the botanical resources in this part of Maui.

RECOMMENDATIONS

The quality of the roads created will have a long term effect on surrounding habitat. Poorly engineered roads in this entire project area quickly erode causing downslope disturbances from moving water and road materials. They have the added effect of necessitating frequent maintenance work resulting in further disturbances. It is recommended that the road surfaces be crowned and rolled with stable material, and that swales, drains and culverts be engineered to channel water from the roadway quickly and effectively.

It is desirable that the incidence of wildfires be minimized because of their devastating long term effects on native plant resources. Fuels in this area are highly flammable. One way to minimize fire here is to limit human access along the road corridor to only those with management or other legitimate functions.

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Appendix 8

KAHEAWA WIND POWER II: POST-CONSTRUCTION REVEGETATION/RESTORATION PLAN

April 2010

I. Introduction

Kaheawa Wind Power II, LLC (KWP II) proposes to construct and operate a new 21-megawatt (MW) wind energy generation facility at Kaheawa Pastures above Mā'alaea in the southwestern portion of the Island of Maui, Hawai'i. The proposed project is situated on approximately 143 acres (58 ha) of State Conservation District Land southeast of the existing 30-MW Kaheawa Wind Power (KWP) project operated and owned by Kaheawa Wind Power LLC (KWP LLC) (KWP II 2009). The proposed project location is referred to as the Downroad Siting Area (Planning Solutions, Inc. 2009).

The area to be disturbed during construction of the KWP II facility is former pasture that was converted from native plant communities well over 100 years ago, and is currently dominated by a mixture of native and non-native grasses and low shrubs with scattered small trees. The area is prone to periodic wildfires, which suppress native plants and favor the spread of non-native, fire-tolerant grasses. Several native plant species are widely scattered throughout the project area, mixed among the non-native grasses (Hobdy 2009b). Native plants are more prevalent at higher elevations of Kaheawa Pastures and in the rocky habitat bordering Manawainui and Malalowaiaole Gulches (Hobdy 2009a, 2009b, 2010).

Construction of the proposed KWP II facility will disturb approximately 43 ac (17 ha) of land. Approximately one third of the disturbed area will be revegetated upon completion of earthwork. Areas suitable for stabilization by revegetation include cut and fill slopes and road cuts. Turbine pads, as well as some portion of the road cuts, will be stabilized with hard materials (e.g., rip-rap and compacted gravel) rather than vegetation in order to ensure stability or increase searchability of turbine plots for downed wildlife.

This plan describes the goals, methods, monitoring, and success criteria for revegetation of areas temporarily disturbed during the construction of KWP II. This plan is intended to meet the dual goals of 1) stabilizing disturbed areas immediately following construction, and 2) re-introducing and establishing several native plant species throughout the site as a longer-term effort. Most elements of this plan involve the application of Best Management Practices (BMPs) and are derived from experiences and lessons learned at the adjacent KWP project site, which underwent construction in early 2006, and which has a comparable plant ecological history.

II. Existing Conditions

The proposed KWP II project area is located in an area known locally as Kaheawa Pastures, on the southern slope of the West Maui Mountains between 695 and 1,825 ft elevation (212 and 556 m). The project area is approximately 4 miles (6.4 km) mauka (inland) of McGregor Point. It is located in the General subzone of the State Conservation District to the southeast of the existing 30-MW KWP facility along the existing access road (Downroad Siting Area). Kealaloloa Ridge, situated immediately northeast of Malalowaiaole Gulch, separates the project area from the isthmus of Maui to the east.

Average annual rainfall at the proposed project area ranges from less than 15 inches (38 cm) per year at the Honoapi'ilani Highway/site access road intersection to slightly over 40 inches (102 cm) per year at the uppermost portion of the existing wind facility (3,200 ft or 975 m). Most of the rainfall occurs during winter months (80+ percent from November through April).

Botanical surveys of the proposed KWP II area were conducted by Robert Hobdy in August 2009 and January 2010. The vegetation is mostly grasses and low-growing shrubs, with occasional small trees in the wetter gullies. The most abundant species in the project area is non-native buffelgrass (*Cenchrus ciliaris*), which proliferated after the fires in 1999 (Hobdy 2009a). Hobdy identified a total of 24 plants native to the Hawaiian Islands, which are widely scattered throughout the area. No state

or federally threatened, endangered, or candidate species were found during his surveys.

III. Background of Revegetation Efforts at KWP

Because of the proximity and similarity of the landscape at the two facilities, the proposed KWP II facility will rely heavily on the lessons learned at KWP. The amended Conservation District Use Permit (CDUP MA-3103) granted to KWP by the Board of Land and Natural Resources (BLNR) on 24 June 2005 contained the following conditions related to revegetation:

20. *"All cleared areas shall be revegetated in a manner consistent with other permit conditions, with specific consideration given to the fire contingency plan and the Habitat Conservation Plan. Any necessary revegetation shall be completed within thirty days of the completion of specific project components that resulted in ground clearing, using native species found in the area;"*
37. *"The applicant shall ensure that operations and maintenance staff do not damage native plants. If construction or operation required the removal of native plants, the plants will be removed, relocated and replanted. The applicant shall pay for the cost of this effort;"*
38. *"The applicant shall work with plant experts to introduce appropriate native plant species back into the Kaheawa Pastures;"*

Similar conditions were required in the National Pollutant Discharge Elimination System (NPDES) General Permit for the KWP project area:

- *"Temporary soil stabilization with appropriate vegetation will be applied to areas remaining unfinished for more than 30 days; and*
- *Permanent soil stabilization will be applied as soon as practical after final grading. Contractor will coordinate with the Department of Land and Natural Resources (DLNR) regarding selection of appropriate vegetation as a condition of the Conservation District Use Permit."*

After extensive research and efforts at seeking source materials, KWP biologists concluded that establishing vegetation within 30 days by seeding with native species (per Condition 20) was not feasible due to the unavailability of native species in sufficient commercial quantities. Currently, the Hawai'i Department of Transportation is working with the Federal Highway Administration on a three-year research project to develop native grass mixes and hydro-seeding techniques for use on civil projects in Hawai'i (Dacus, pers. comm.). However, techniques have not yet been developed in Hawai'i for hydro-seeding or broadcasting with native seed mixes on a large scale.

In the *Response to October 27, 2005 Letter Regarding the Establishment of Stabilizing Vegetation Cover for Erosion and Sediment Control Related to Wind Farm Access Road Construction*, the State of Hawai'i Department of Land and Natural Resources (DLNR) authorized KWP's request to apply commercially available annual ryegrass (*Lolium multiflorum*) in order to comply with permit conditions of the CDUP and the NPDES permit, given the following conditions:

1. *"The permittee shall acquire commercial quantities of native pili grass bundles or other native species as soon as possible to substitute the annual rye; and*
2. *The permittee is responsible for controlling the annual rye if it starts invading adjacent State lands."*

KWP subsequently established a conservation partnership with the USDA/NRCS to obtain native pili grass (*Heteropogon contortus*) from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) Plant Materials Center on Moloka'i. This partnership resulted in field trials to test the ability to establish pili grass at KWP using seed and bales. Following several treatments, it was determined that while it is possible to establish pili grass in limited quantities, and

over several months, it probably cannot be expected to meet rapid, site-wide ground cover re-establishment requirements.

Following the trials with pili grass, KWP petitioned DLNR and the Office of Conservation of Coastal Lands (OCCL) to consider allowing manual application and hydro-seeding with a grass seed mixture to accomplish site revegetation goals. DLNR officials in the Division of Forestry and Wildlife (DOFAW) provided comments on this proposal, citing that annual ryegrass is expected to die off and provide a more suitable environment for recruitment by adjacent species. DOFAW expressed interest in limiting the amount of emergent grass in the immediate vicinity of turbines, a recommendation intended to minimize the attraction of Nēnē, which are common in the area and browse on a wide range of emergent vegetation types. KWP biologists have documented that Nēnē are prevalent in the area and currently use the areas in proximity to the existing turbines on a regular (i.e., almost daily) basis. Thus, revegetating bare areas with grasses is not expected to pose an additional risk of bird collisions.

At the same time, KWP biologists have had considerable success at re-introducing native plants grown in the nursery at various locations throughout the site, including along cut and fill slopes and other open earth portions of the roadsides and turbine pads. Although these plantings do not provide a uniform stabilizing cover *per se*, it does appear that they will, over several seasons, come to dominate the areas treated. Between July 2007 and June 2008, approximately 7,500 young a'ali'i (*Dodonaea viscosa*) were propagated from seed collected at Kaheawa and planted along cut and fill slopes and other open earth portions of the roadsides and turbine pads. An intensive outplanting effort comprising nearly 16,000 individual plants of several key native species occurred during the winter and spring of 2009 at KWP.

IV. Revegetation Goals

The goals of the revegetation plan for KWP II are based on the relevant CDUP and NPDES permit conditions for KWP, as well as experiences and lessons learned at KWP.

The proposed revegetation strategy for KWP II has two goals:

1. Address the immediate requirement of stabilizing exposed soils following construction activities at KWP II, in accordance with erosion and sedimentation control BMPs and NPDES stormwater discharge permitting requirements; and
2. Re-introduce native plant species in selected areas throughout the site over several years, with the goal of re-establishing native plant species in areas that have been overgrown with non-native species for a century or more.

V. Revegetation Methods

KWP II biologists will work alongside the DLNR-DOFAW specialists to ensure that revegetation methods consider and incorporate all wildlife, forestry, fire, and rangeland concerns and are in alignment with the management provisions of the Conservation District. All revegetation material brought to the project area (e.g. seed mixes, sand, gravel, rock, and mulch) will be certified as weed free by the Hawai'i Department of Agriculture (HDOA) prior to entering the project area.

KWP II will work with construction contractors to ensure that slopes are not excessively compacted so as to inhibit establishment of vegetation. No other site preparation (e.g. weeding, adding soil amendments, etc.) is anticipated to be necessary prior to revegetation.

Hydroseeding (Goal 1):

KWP II biologists propose to hydroseed disturbed areas along the edges of turbine pads and along road cuts and fill slopes with annual ryegrass to establish an initial cover of vegetation after ground shaping and grading activities have been completed (Figure 1). Annual ryegrass was selected for erosion control because it provides rapid initial vegetation cover and forms an extensive, dense root system (Valenzuela and Smith 2002). This species is expected to gradually die back and allow natural

recruitment of neighboring species or species present in the seed bank (DOFAW, personal communication). Hydroseeding with annual ryegrass will require supplemental irrigation for a 90-day period and monitoring to ensure establishment of stabilizing cover.

Erosion Mats and Hard Materials (Goal 1):

Excessively steep areas may require additional erosion control to achieve the immediate goal of stabilizing exposed soils and preventing erosion. For example, certain sections of the site may require the use of organic coir or jute mats and/or coir logs to reduce water flow velocity and capture sediments and seed material during periods of seasonal rainfall. The mats or logs will be secured in place along steep fill slopes and grades to provide temporary erosion control during the initial establishment period and further contribute to ground cover establishment. In addition, some portion of the disturbed area (particularly the turbine pads) will be stabilized with hard materials (e.g., rip-rap, compacted gravel) rather than vegetation in order to ensure stability and facilitate monitoring of turbine plots for downed wildlife. The use of these materials will be evaluated in consultation with DLNR and the U.S. Fish and Wildlife Service (USFWS), and implemented according to site-specific considerations.

Outplanting (Goal 2):

To accomplish the long-term goal, KWP II biologists propose to re-introduce native plants in discrete locations over several years, with the intent of eventually re-establishing some of the key elements of the plant communities that historically existed on the site (Figure 2). This phase will involve collecting native seeds and cuttings in the area, propagating these species at local nurseries, and subsequently outplanting these species at the site.

Native species that may potentially be used during this phase include 'a'ali'i (*Dodonaea viscosa*), pili grass (*Heteropogon contortus*), 'ūlei (*Osteomeles anthyllidifolia*), and 'ilima (*Sida fallax*). These relatively fast-growing and easily propagated species provide excellent root structure for maintaining surface substrate retention, as well as provide a native seed source for the project area. Pili grass and 'a'ali'i are particularly appropriate for Kaheawa Pastures because these species are among the few native Hawaiian plants shown to be fire tolerant (Tunison et al. 1994, Loh et al. 2009).

The specific species, sizes, densities, and location of native outplantings will be determined based on site-specific factors such as slope, erosion potential, and substrate. Due to physical constraints of the site (i.e. the presence of surface bedrock material), KWP II LLC may concentrate native outplants outside of the area disturbed during construction (i.e. near the pu'u). This location will be determined in consultation with DLNR, USFWS, and a revegetation/restoration specialist.

Because this phase will occur after the immediate revegetation phase, many of these plantings will be installed in or adjacent to areas that were previously stabilized with the annual ryegrass mixture and temporary measures (e.g., coir mats and logs). In certain cases, it may be necessary to remove or control undesirable non-native species, either manually or with the assistance of an approved herbicide. Any use of herbicides will be done only in consultation with DLNR, and only in accordance with applicable restrictions on handling and use.

KWP II biologists plan to approach this phase of the site revegetation plan in a manner that emulates the successful native plant reintroduction efforts at KWP. KWP II will work in collaboration with KWP to share resources and coordinate logistics.

VI. Timeline

Construction of the access roads and turbine foundations is anticipated to begin shortly after issuance of the Federal Incidental Take Permit (ITP) and State Incidental Take License (ITL). Revegetation of temporarily disturbed area with annual ryegrass will begin as soon as possible immediately after construction of the access roads and turbine foundations. Outplanting with native species will occur during the first several years of the project. Some species will be outplanted immediately after hydroseeding with annual ryegrass to take advantage of irrigation.

VII. Monitoring and Success Criteria

Regular irrigation and monitoring will be necessary at KWP II to ensure that immediate revegetation measures are successful. Young grasses and seedlings are especially vulnerable to root damage in the absence of rain or watering. All hydroseeded areas will be monitored and irrigated for a 90-day period following hydroseeding. The revegetation/restoration contractor shall provide sufficient irrigation during this period to assure adequate survival.

This phase of the project will be considered successful if it can be demonstrated that >75% of the bare areas, fill slopes, and road cut segments that receive treatment have established cover within one year following treatment. If initial applications appear to be only partially successful, subsequent hand and/or hydro-seeding applications or additional temporary measures (e.g., matting or logs) may be installed to ensure adequate coverage and erosion control.

The longer term revegetation efforts at KWP II are expected to be very successful given the success at KWP. A well-established seed collection and propagation program exists in cooperation with local nurseries, other native plant specialists, contract landscape specialists, and volunteers. Plants will be outplanted and maintained, monitored, and documented using resources available at KWP II and in collaboration with community and conservation groups. This effort will be considered to be successful if a minimum of 5,000 individual plants are installed during the first three years following construction, with an average survival rate of greater than 75% (i.e., a minimum of 3,750 surviving plants), for all plants one year after installation, as determined by representative sampling of planted areas. If mortality exceeds 25%, replacement plantings will be installed as needed to achieve the 75% minimum.

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Figure 1. Mechanized hydroseeding along a bare road cut during immediate site revegetation and soil stabilization efforts following construction at KWP.



Figure 2. Several native plant species successfully outplanted at KWP as part of long-term revegetation efforts.

Appendix 9

**An Assessment of Hawaiian Native Molluscan Fauna
of the lower Kaheawa Pasture, West Maui, Hawai‘i**

TMK (2) 3-6-01 : 14

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Introduction:

The terrestrial molluscan fauna of Hawai'i is in a state of catastrophic decline in which hundreds of species and an endemic family are in danger of extinction. Hawai'i's molluscs evolved in isolation with an ecological naivety that has left them extremely vulnerable to environmental change, and a low fecundity that has not allowed them to recover from the pressures exerted by introduced predators. During the late 20th century perhaps as many as two-thirds of the living species described in the 19th and early 20th centuries became rare or extinct.

This survey was commissioned by First Wind to determine if any species of native Hawaiian snails, particularly those species listed by federal or state agencies as threatened, endangered, or of substantial conservation concern, remain within or along the borders of the lower Kaheawa Pasture, and if so what steps should be taken to insure their continued survival.

During the survey rock talus and grasses were searched for living snails, and soil samples were screened for living and dead snails to 1 mm in diameter. Two species of extant snails were located representing two families – one, an undescribed species of Vertiginidae, the other a species of Succinidae.

Site Description:

The lower Kaheawa Pasture lies in the Lahaina District in the ahupua'a of Ukumehame and is defined by the upper reaches of Manawainui Gulch on the southwest and by Malalowaia'ole Gulch on the north. The area surveyed was located between these two gulches and consisted of a gently undulating pasture with a slight slope of 17 degrees and the upper edges of the gulches themselves. The elevation range was approximately 258 - 577 meters. Much of the pasture was burned in 2006 in the most recent of many wind-driven fires that consumed the vegetation on the gulch slopes and the flat, grass-covered pasture.

Remnants of an old road snake up the pasture on the southwest side of the First Wind access road which lies to the north of the approximate center of much of the survey area. Along the upper edges of the gulches that define the survey area are periodic rock outcroppings, low rock cliffs and rock talus, the latter being generally overgrown with taller grass than that seen in the pasture. These talus areas are of particular interest because they form good dryland snail habitat as well as offer the potential to find semi-fossil snail shells, which might indicate the presence of species not encountered alive during the survey or species that may have existed in the survey area prior to the activity of First Wind.

At the time of the survey the top of the pasture was covered with a knee-high grass and sporadic woody shrubs, many of which were blackened and appeared to be recovering from the last fire in 2006. The substrate is a hard packed sun-dried soil covered with

loose rocks. Occasional rock outcroppings are scattered throughout the pasture and appear to be remnants of the volcanic flows that cap what is now the ridge.

Biological History and Potential:

Prior to European contact much of the pasture was probably covered in woody shrubs and trees of the Hawaiian low elevation dryland forest; grasses; and occasional ferns, with the horizontally growing uluhe fern probably being found in the highest elevation surveyed. Little or no habitat would have been available for arboreal snails; however, ground-dwelling snails were found in similar dryland habitats statewide and some are still extant in other such areas on Maui.

There is no record of land snails having been found in the area of the survey; however, based on previous collections of Hawaiian dryland snails, species of the following four families might have been present at one time.

Species of the family Succinidae are known from similar dryland habitat on the lower western slopes of Haleakala; a species of Endodontidae is known from fresh dead shells collected in a small gulch on the Lahaina side of West Maui several miles from the survey area; species of ground-dwelling Achatinellidae are known to exist at the base of grasses on some of the dry, remnant islands of the northwestern Hawaiian chain and were no doubt found in similar habitat throughout the Hawaiian Islands; and species of Vertiginidae are known to have inhabited grass and leaf litter in dryland areas throughout the island chain.

An extensive search of the literature, however, showed no indication that species from these families have ever been collected from the survey area. If snails had been collected in the survey area they were probably species already known to early collectors from other areas and thus were not considered of interest.

Survey Objectives:

This survey and report were initiated out of concern that there may be native snail populations within, or reasonably close to, the lower Kaheawa Pasture region and proposed Kaheawa Wind Power facility. The objectives were to determine if any native land snail species were present in the survey area, to identify them and to try to determine their habitat. Another objective was to look for semi-fossil shells protected beneath rocks or buried in the soil, which could indicate what species might have been present in the area at one time.

Habitat Requirements:

The habitats preferred by the Hawaiian lowland molluscan fauna are determined by available vegetation and moisture. Considering the sparse vegetation and dry conditions of the survey area the search for living land snails was restricted to rock talus, rock cliffs and other rocky features scattered in the pasture where the roots of grasses help maintain

moisture beneath the rocks and deep in cracks. This kind of habitat is common along the upper edges of the defining gulches but uncommon in the open pasture.

Method:

A preliminary examination and initial survey of the area showed that the best habitat existed along the edge of the gulch on the windward side of the survey area. A series of stations was established based on available habitat along the upper edge of the gulch and a transect determined by the elevational contour of each station was followed horizontally across the pasture, as Hawaiian snails are known to be sensitive to elevation on the steep slopes of West Maui.

Species Discovered:

Of the four potential families expected to be found in the survey area, two families had living representatives and two families did not. As expected, both species were found in protected, moist habitat beneath rocks.

The Succinid, *Succinea mauiensis* Ancey, 1889, is present throughout the pasture within undisturbed rock outcroppings where it attaches to the moist undersides of closely-packed rocks or in the root mat of grasses beneath the rocks. It was not found beneath the loose surface rocks which litter the pasture but have no root mat.

This species is known to have a wide range in dry habitat on East and West Maui. The *S. mauiensis* present in the survey area were uncommon in the pasture compared to the upper edges of the gulches. One live specimen was collected and preserved in an RNA/Later solution for further study, and dead specimens were collected when encountered for identification purposes.

In addition to the Succinid, an undescribed species of Vertiginidae of the genus *Nesopupa* was discovered in similar habitat. This new species was seen in only one location along the upper edge of Malalowaia'ole Gulch at an elevation of 446 meters and represents a fifth species of the genus to be found on Maui.

After the initial discovery of the first specimen a one-square-meter area was examined closely on two occasions. A total of 9 *Nesopupa* specimens were collected including four fresh fragments, four intact dead shells and one live specimen. The live specimen was collected for descriptive purposes. One other live specimen was noted and left.

Conservation Relevance:

In general dryland species appear to have an advantage in surviving the introduced predatory snails which have devastated the native molluscan fauna because their preferred habitat is too dry for these predators to survive. In addition, the habitat of the two living species found within the survey area has proven to be resilient, as it has apparently survived 100 years of grazing cattle and periodic fires.

Discussion:

Finding lowland snails in the survey area was not a surprise, though finding an undescribed species of *Nesopupa* was, and indicated that the area has never been thoroughly explored for Hawaiian snails.

The two species found in the survey area are numerous when located. Thus, there is reason to believe that both species may exist in similar habitats beyond the boundaries of the property surveyed on neighboring ridges and in neighboring gulches.

Of the two species located during the survey, only *Succinea mauiensis* is found in the area proposed to be developed, and then only in several rock outcroppings associated with small ravines scattered within the pasture. The undescribed *Nesopupa sp.* is found in an area not scheduled to be developed.

For these reasons careful planning and caution should suffice to protect these species. In fact, they may eventually prosper as the use of the pasture becomes stabilized, is protected more vigorously from fires and is regulated by First Wind.

The attention First Wind has given to this important but devastated aspect of Hawaiian biology is commendable, but it appears that years of abuse of the land prior to First Wind has destroyed much of the habitat available to these snails, reducing the potential habitat for living snails to islands of rock outcroppings. More than 99% of the land within the survey area is now completely devoid of snails and their habitat.

Conclusion:

First Wind has shown by this survey that the degradation of an area through decades of grazing and periodic fires was no reason to ignore the possibility that endemic Hawaiian snails and their micro-habitat might yet survive. This prudence has not only demonstrated snails can and do survive in extreme conditions, but that new species may yet be discovered where least expected, adding more to our knowledge of this fragile fauna.

GPS Coordinates:

GPS coordinates are given here for the five stations along Malalowaia'ole Gulch and the species found at each.

20°48.224 – 156°32.409 No snails present. Elevation 577 meters.

20°47.706 – 156°32.145 *Nesopupa n. sp.* and *Succinea mauiensis* Ancey, 1889.

Elevation 446 meters.

20°47.537 – 156°31.996 *Succinea mauiensis* Ancey, 1889. Elevation 350 meters.

20°47.335 – 156°31.855 No snails present. Elevation 282 meters.

20°47.275 – 156°31.832 meters. *Succinea mauiensis* Ancey, 1889. Elevation 256 meters.

Species Analysis:

Family Succinidae

Succinea mauiensis Ancey, 1889 was compared with an image of a specimen from the Museum of Comparative Zoology at Harvard, MCZ# 039616 (possible lectotype).

Family Vertiginidae

Nesopupa n. sp. was compared with the following *Nesopupa* which represent all the known species from Maui, Kaho‘olawe, Lana‘i and Moloka‘i.

Nesopupa (Nesopupilla) baldwini Ancey, 1904

1.2 mm. Maui. MCZ 078790 Paratype.

Nesopupa (Nesopupilla) baldwini lanaiensis Pilsbry & Cooke, 1920

1.6 mm. Lana‘i. MCZ 078778 Paratype.

Nesopupa (Nesopupilla) baldwini subcostata Pilsbry & Cooke, 1920

1.5 mm. Moloka‘i. MCZ 180174.

Nesopupa (Infranesopupa) bishopi Cooke & Pilsbry, 1920

2.15 mm. Maui. BPBM 12465 Holotype.

Nesopupa (Nesopupilla) dispersa Cooke & Pilsbry, 1920

1.4 mm. Kaho‘olawe. MCZ 078785 Paratype.

Nesopupa (Infranesopupa) dubitabilis Cooke & Pilsbry, 1920

1.2 mm. Moloka‘i. MCZ 078797 Paratype.

Nesopupa (Limbatipupa) newcombi (Pfeiffer, 1853)

1.3 mm. Lana‘i. MCZ 045244 Lectotype.

Nesopupa (Limbatipupa) newcombi seminulum (Boettger, 1881)

1.2 mm. Moloka‘i. MCZ 180179.

Nesopupa (Infranesopupa) limatula Cooke & Pilsbry, 1920

1 mm. Maui. ANSP 44692 Paratype.

Nesopupa (Limbatipupa) singularis Cooke & Pilsbry, 1920

1.0 mm. Maui. ANSP 44697.

Nesopupa (Nesodagys) wesleyana rhadina Cooke & Pilsbry, 1920

2 mm. Moloka‘i. MCZ 078793 Paratype.

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Appendix 10

Calculating Total Direct Take

Monitoring efforts at KWP II as prescribed in the KWP II HCP will result in identification of “observed” mortality, which is a statistical sampling of all mortality directly attributable to project operations. Identifying the total mortality (or “total direct take”) requires accounting for individuals that may be killed by collision with project components but that are not found by searchers for various reasons, including heavy vegetation cover and scavenging. The calculation for estimating total direct take is:

Total Direct Take = Observed Direct Take + Unobserved Direct Take

Searcher efficiency (SEEF) trials and scavenger trials are conducted to arrive at estimates of unobserved direct take (See Appendix 2). SEEF trials measure how effective searchers are in finding carcasses within the search areas and scavenger trials measure the length of time carcasses remain in the field before being removed by scavengers. Scavenger trials are often used to determine the frequency at which turbines and met towers can be searched to maximize the likelihood of searchers detecting carcasses while maintaining a cost-effective survey schedule. Factors to be considered for SEEF trials and scavenger trials for KWP II include season, carcass size, and vegetation type.

Numerous estimators have been developed for the calculation of unobserved direct take. The variables these estimators often include are SEEF, search intervals, and carcass retention rates within the search intervals. Newer estimators are frequently incremental improvements over older estimators as biases and deficiencies of each estimator become clearer as data accumulates. KWP II, LLC examined three estimators, Shoenfeld (2004), Jain (2007), and Huso (2008), in the development of the calculation to be used for determination of total direct take for its project.

The estimators are presented below:

Estimator by Shoenfeld (2004)

$$m = \left(\frac{N * I * C}{k * t * p} \right) \left(\frac{e^{I/t} - 1 + p}{e^{I/t} - 1} \right)$$

N= total number of turbines

I = interval between searches in days

C = total number of carcasses detected for the period of study (total direct take)

k= number of turbines sampled

t = mean carcass removal time in days

p = searcher efficiency (proportion of carcasses found)

e = natural log

Shoenfeld (2004) and its derivatives were found to bias total direct take calculations low as carcass retention rates (t) increased, particularly when search intervals (I) were small (Smallwood 2007, Huso 2008a, b). The weakness of the estimator resulted from the t/I not being a good estimate of scavenger efficiency (or proportion of carcasses remaining) and this bias also became more pronounced as searcher efficiency (p) became low (Huso 2008a, b).

Estimator by Jain (2007)

$$\hat{C} = \frac{C}{S_c \times S_e \times P_s}$$

\hat{C} = total number of carcasses for the period of study (total direct take)

C = number of carcasses found

S_c = scavenger efficiency (proportion of carcasses remaining)

S_e = searcher efficiency (proportion of carcasses found)

P_s = proportion of towers searched

Jain (2007) tried to avoid the bias present in the Shoenfeld (2004) estimator by directly incorporating scavenger efficiency or proportion of carcasses remaining (S_e) into his proposed estimator. Jain (2007) assumed that carcasses had equal probability of occurring on any day between search intervals, thus the average number of days a carcass was present was half the number of days between searches and S_e was determined empirically in scavenger trials for a specified time period (in this case half the search interval). This method proposed for determining S_e is fairly simplistic as scavenger efficiency is non-linear but approximates a logarithmic function (Smallwood 2007). Methods to estimate S_e have subsequently been improved on by Huso (2008a, b).

Estimator by Huso (2008)

$$\hat{m}_{ij} = \frac{c_{ij}}{\hat{r}_{ij} \hat{p}_{ij} \hat{e}_{ij}}$$

\mathbf{m}_{ij} = estimated total direct take at turbine i over interval j

\mathbf{c}_{ij} = observed direct take

\mathbf{r}_{ij} = estimated proportion of carcasses remaining after scavenging

\mathbf{p}_{ij} = estimated searcher efficiency (proportion of carcasses found)

\mathbf{e}_{ij} = effective search interval

The recently introduced estimator by Huso (2008a, b) has several improvements over the previous two estimators. For estimating the scavenger efficiency or the proportion of carcasses remaining within a specified search interval (r_{ij}), Huso (2008a, b) accounts for the logarithmic nature of carcass removal, and also accounts for the removal of older carcasses over time while newer carcasses are being simultaneously deposited during the search interval. Huso (2008) has further developed methods to determine effective search intervals (e_{ij}) for cases where search intervals are much longer than the estimated carcass retention times (i.e. carcasses deposited early on in the search interval are 99% removed by scavengers before the subsequent search). Simulations run to determine the degree of bias for the different estimators has shown that the Huso (2008a, b) estimator is the least susceptible to bias over a wide range of values for each variable and is currently the most precise of the commonly used estimators (Huso 2008a, b).

Estimating Total Direct Take at KWP II

In the light of the recent improvements to estimators for calculating total direct take, KWP II, LLC proposes to apply the Huso (2008a, b) estimator to the monitoring protocol proposed for KWP II in Appendix 2. Three factors will be considered for scavenger trials and SEEF trials - season, carcass size, and vegetation type. The values obtained from the scavenger and SEEF trials will then be applied to the Huso (2008a, b) estimator using the following protocol:

1. Determine proportion of different vegetation types (bare ground, grass) under all turbines combined for search area less than 50% turbine height and search area between 50-75% turbine height. Please see Appendix 2 for the definition of search areas.
2. Conduct SEEF trials for each vegetation type. Calculate variances for SEEF trials for each vegetation type per season. Conduct statistical tests to determine if searcher efficiency varies with vegetation type. Pool SEEF values for vegetation types that are not significantly different.
3. Determine mean carcass removal time for each vegetation type. Calculate variances for carcass removal time for each vegetation type per season. Conduct statistical tests to determine if carcass removal rates vary with vegetation type. Pool carcass removal rates for vegetation types that are not significantly different.
4. Determine effective search interval for each carcass size for each vegetation type.
5. Apply values to Huso (2008a, b) formula for 50% and 50-75% search areas (see example).
6. The percent of direct take of birds within the 50% turbine height search area vs. the total number of birds taken within the entire searched area will also be calculated. This percentage will then be used as a correction factor and applied to determine direct take for the entire search area (0 - 75% turbine height) at such time when the search intensity is decreased and the areas beyond 50% turbine height are no longer searched. Should the sample size at the end of the intensive search period be so small that an accurate correction factor cannot be obtained, correction factors for each carcass size will be calculated based on data from other wind farms that have had similar sampling regimes and adequate sample sizes.
7. Methods to determine variances and confidence intervals for total direct take are currently being developed by M. Huso (Huso 2008a, Huso pers. comm.). When such methods become available, KWP II will apply confidence intervals to the estimated total direct take.

An example of using Huso (2008) to calculate total direct take of a medium-sized bird (Hawaiian petrel) for one season (Summer and Fall combined, June - November) is presented. For illustrative purposes, an observed take of five petrels within the 50% search area and one petrel in the 50-75% search area is assumed. The theoretical search protocol is as follows:

All 14 turbines on site will be searched twice weekly (approximately 4-day intervals) to 50% turbine height. 75% turbine height search areas for **seven** turbines will be searched weekly. The remaining seven turbines will be searched to 75% the following week. Thus each turbine will be searched to 75% every two weeks (14 days). Please see Appendix 2 for further details on the proposed monitoring protocol for KWP II.

Example of Calculation of Direct Take Using Huso (2009) for Hawaiian Petrel in Winter

Main equation

$$\hat{m}_{ij} = \frac{c_{ij}}{\hat{r}_{ij} \hat{p}_{ij} \hat{e}_{ij}}$$

Eq 1

$$\text{If } f(x) = \lambda e^{-\lambda x}; S(x) = e^{-\lambda x}$$

Eq 2

$$d_{99} = \min(x : S(x) = 0.01, I), \hat{e} = \frac{d_{99}}{I}$$

Eq 3

$$\hat{\lambda} = 1 / \bar{t};$$

Eq 4

$$\hat{r} = \frac{\int_0^{d_{99}} e^{-\lambda x} dx}{d_{99}} = \frac{(1 - e^{-\lambda d_{99}})}{\lambda d_{99}}$$

m_{ij}	estimated mortality
r_{ij}	estimated proportion of carcasses remaining after scavenging
p_{ij}	estimated searcher efficiency
c_{ij}	observed take
I	search interval
e_{ij}	effective search interval
d₉₉	days to 99% of carcasses removed
t	mean carcass retention time (scavengers)

Example of Calculation of Direct Take Using Huso (2009) for Hawaiian Petrel in Winter

Season

Winter

Search area	50% turbine height			75% turbine height	
	Vegetation type	bare ground	grass	unsearchable	
Proportion		0.75	0.25	0.00	
Petrel Size (SEEF) likelihood of detection (p_{ij})		1.00	0.81		
Mean Carcass removal time (t) (days)		11	11		
No of carcasses (c_{ij})		3	2		
λ (Eq3)		0.09	0.09		
d_{99}		49.28	49.28		
I		4	4		
d_{99} (Eq 2 applied)		4	4		
e_{ij}		1	1		
Eq4					
λd_{99}		0.37	0.37		
r_{ij}		0.83	0.83		
m_{ij}		3.60	2.96		
total mortality		6.55			
total mortality including unsearchable areas		6.55			
Total direct take for entire area		9			
		(=8.88)			
Correction factor		1.35			

References:

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Appendix 11

Seabird Mitigation Alternative 1:

Makamaka'ole Seabird Mitigation and Management Plan (with KWP and KWP II)

Calendar Year	Task/Item	By	Estimated Cost (\$1,000s)	Project Share		
				KWP	KWP II	Kahuku
2010	<ul style="list-style-type: none"> Site reconnaissance and avian activity observations Preliminary fence location and layout with DLNR and USFWS Possible preliminary social attraction/burrow installations Site investigations by botanist and cultural expert Prepare feasibility assessment by September 1, 2010 Reach decision on feasibility with agencies If project is feasible, prepare EA and file permit applications 	Project Staff/ Consultant	100	75		25
2011	<ul style="list-style-type: none"> Permit application review and processing Solicit bids/select contractor Follow-up reconnaissance/construction planning 	Project Staff/ Consultant	100		75	25
	<ul style="list-style-type: none"> Begin construction of approx. 2 miles of fence in late 2011 	Contractor	250	75	100	75
2012	<ul style="list-style-type: none"> Complete fence construction 	Contractor	250	75	100	75
	<ul style="list-style-type: none"> Intensive predator trapping/bait boxes Social attraction and artificial burrows Monitoring 	Project Staff/ Interns	100	25	50	25
2013	<ul style="list-style-type: none"> Mop-up predator trapping Continue bait boxes Social attraction and artificial burrows Monitoring 	Project Staff/ Interns	75	25	25	25
2014	<ul style="list-style-type: none"> Inspections (fence/predator) Bait boxes Social attraction and artificial burrows Monitoring 	Project Staff/ Interns	75	25	25	25
2015	<ul style="list-style-type: none"> Inspections (fence/predator) Bait boxes Social attraction and artificial burrows Monitoring 	Project Staff/ Interns	75	25	25	25
2016-2030	<ul style="list-style-type: none"> Social attraction continues in 2016 Inspections (fence/predator) Bait boxes \$25,000/yr for 15 years 	Project Staff/ Interns	375	75	150	150
Totals			1400	400	550	450

Seabird Mitigation Alternative 2:

Multi-Project Plan for Hawaiian Petrel at Haleakala National Park and Newell's Shearwater on Kauai

Calendar Year	Task/Item	By	Estimated Cost (\$1,000s)	Project Share		
				KWP	KWP II	Kahuku
2010	<ul style="list-style-type: none"> • Prepare Makamaka`ole feasibility assessment by September 1, 2010; reach decision on feasibility with agencies • If Makamaka`ole is infeasible or not preferred proceed with Haleakala/Kauai options • <u>Haleakala Petrel Colony:</u> <ul style="list-style-type: none"> ◦ Coordinate with National Park Service, define Haleakala colony management area, prepare draft plan, submit for agency review ◦ Execute necessary agreements with NPS, obtain necessary permits and authorizations • <u>Kauai Shearwater Colony (assumes no island-wide HCP option):</u> <ul style="list-style-type: none"> ◦ Coordinate with Hawaii DOFAW, identify several Kauai colony management options 	Project Staff/ Consultant Support	125	75	25	25
2011	<ul style="list-style-type: none"> • <u>Haleakala Petrel Colony:</u> <ul style="list-style-type: none"> ◦ Complete final plan, complete permits, authorizations and agreements ◦ Solicit resumes/select field staff, procure equipment and materials ◦ Lay out management area and trapping array ◦ Commence trapping in accordance with approved plan • <u>Kauai Shearwater Colony (assumes no island-wide HCP option):</u> <ul style="list-style-type: none"> ◦ Conduct field recons, define colony management site ◦ Prepare draft/final plans, obtain agency approvals ◦ Execute agreements with landowner, obtain necessary permits and authorizations 	Project Staff/Consultant Support	175	50	100	25
2012	<ul style="list-style-type: none"> • <u>Haleakala Petrel Colony:</u> <ul style="list-style-type: none"> ◦ Continue trapping in accordance with approved plan ◦ Work out bugs in program • <u>Kauai Shearwater Colony (assumes no island-wide HCP option):</u> <ul style="list-style-type: none"> ◦ Complete agreements with landowner, complete necessary permits and authorizations ◦ Solicit resumes/select field staff, procure equipment and materials ◦ Commence trapping/management in accordance with approved plan 	Project Staff/ Interns	200	50	100	50

2013	<ul style="list-style-type: none"> • <u>Haleakala Petrel Colony:</u> <ul style="list-style-type: none"> ◦ Continue trapping in accordance with approved plan • <u>Kauai Shearwater Colony (assumes no island-wide HCP option):</u> <ul style="list-style-type: none"> ◦ Continue trapping/mgmt in accordance with approved plan ◦ Work out bugs in program 	Project Staff/ Interns	75	25	25	25
2014- 2030 (KWP permit expires 2026)	<ul style="list-style-type: none"> • <u>Haleakala Petrel Colony:</u> <ul style="list-style-type: none"> ◦ Continue trapping @ \$50K/yr for 7 yrs in accordance with approved plan (assumes 7 add'l years needed to fulfill mitigation obligations) • <u>Kauai Shearwater Colony (assumes no island-wide HCP option):</u> <ul style="list-style-type: none"> ◦ Continue trapping/mgmt @ \$50K/yr for 8 yrs in accordance with approved plan (assumes 8 add'l yrs needed to fulfill mitigation obligations) 	Project Staff/ Interns	750	225	350	175
Totals			1325	425	600	300

Appendix 12

Kaheawa Wind Power II Habitat Conservation Plan

Construction Phase Nēnē and Nest Survey Protocol

INTRODUCTION

Surveys for nēnē and nēnē nests will be conducted by a qualified biologist, ornithologist, field ecologist or similarly experienced professional, prior to any clearing, grading, selected drill-and-shoot dense substrate fracturing, or construction of project roadways, turbines and accessory facilities. These surveys will be conducted as avoidance and minimization measures as prescribed in the project's Habitat Conservation Plan and are a requirement of the Conservation District Use Permit issued to Kaheawa Wind Power II (KWP II) by the DLNR.

Section 9 of the Endangered Species Act (ESA) prohibits the "take" of any endangered or threatened species of fish or wildlife listed under the ESA. Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect species listed as endangered or threatened, or to attempt to engage in any such conduct. "Harm" in the definition of "take" in the ESA means an act which actually kills or injures wildlife, and may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). "Harass" in the definition of take in the ESA means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3).

Section 195D-4, Hawai'i Revised Statutes, states that any endangered or threatened species of fish or wildlife recognized by the ESA shall be so deemed by State statute. Like the ESA, the "take" of such endangered or threatened species is prohibited [Section 195D-4(e)]. The definition of "take" in Section 195D-2 mirrors the definition of the ESA: "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species of aquatic life or wildlife...or to attempt to engage in any such conduct."

The nēnē nesting season typically begins in October and ends in April. Although nēnē are not believed to use the KWP II project area as preferred nesting habitat, they may still be present in the project area during the nesting and non-nesting season. Therefore, construction activities occurring from May through September would typically be the least likely to encounter nēnē nesting in the project vicinity.

FIELD METHODS

Timing Surveys for Optimal Reliability

Surveys to identify nēnē or nēnē nests in project construction areas should be conducted in a timeframe as close as possible to anticipated construction activities in order for the survey to accurately represent the occurrence of birds or newly established nests in proximity to these areas. Because nēnē are mobile and have the ability to readily move among different portions of the project area, the reliability of a survey depends largely on it being performed immediately before construction activities are expected to commence.

The timing and protocol for conducting pre-construction surveys during the nesting season will be confirmed through consultation with DOFAW and USFWS prior to surveys being conducted to ensure that there is confidence in the survey methods and results such that the subsequent proposed construction activity can be safely undertaken.

DOFAW and Kaheawa Wind Power biologists have agreed to work in close collaboration during construction phase nēnē monitoring at KWP II.

Search Area

The area surveyed for Nene presence or nesting activity should cover the entire area where such construction activity will occur, and will extend a distance of 100-200 meters (328-656 feet) further on either side of these areas, depending on the specific type of construction activity being performed. For example, if roadway construction on a turn will involve cut-and-fill in an area that is 50 feet wide, this area plus 100 meters on either side must be searched. Similarly, if drill-and-shoot charge detonations are required to loosen dense rock and substrate prior to excavation, the area that will be searched may extend 200 meters. The size of the search area on any given day will depend on which areas are planned for construction activities and what specific construction activities are planned, while spacing and configuration of transects will be dependent upon topography and vegetation in the area, and subject to the surveyor's qualified opinion..

Construction Monitoring

KWP II will provide a biologist who will inspect areas of proposed active construction for evidence of nests, adult birds and/or young, for a period leading up to and immediately prior (same day) to construction work proceeding. During the nesting period, once an area is searched and determined to be "cleared" (of nene nests and or family groups with un-flighted goslings), KWP II biologists may, where practicable and warranted, place a temporary orange construction fence or similar barrier at the edge of the surveyed area to designate the limits of the area that has been "cleared". This temporary fence material may be moved and re-used as surveying and construction proceeds, but will not be left in the field indefinitely.

If nests or birds are found, the discovery protocol provided in the following section will be followed.

DISCOVERY PROTOCOL

Discovery During Clearing Surveys

Should any nēnē or nests be found during a survey, DOFAW and USFWS will be contacted and will advise the on-site biologist in-charge of monitoring at KWP II how to proceed, on a case-by-case basis, depending on the location and status of the birds or nest. It is important to note the case-by-case nature of this protocol, as there are many factors that DOFAW, USFWS, and KWP II will consider if birds and/or nests are discovered in the project area, including: topography and terrain; vegetation and adjacent habitat; recent weather; proximity to proposed construction activity; status of nest and eggs and the age, health and behavior of goslings and/or adults.

If a nest is found during pre-construction clearing surveys, the following measures will likely be required, in varying degrees:

- Construction will likely be prohibited from commencing within a certain perimeter of the nest for an appropriate period of time;
- Subsequent monitoring of the nest may be required to ensure that the nest, eggs, chicks and adults are not disturbed by project activities nearby and elsewhere;
- Temporary fencing or other protection barrier, where specifically warranted may be required to protect the nest from nearby activity; or the nest may be relocated by agency officials.

DOFAW and USFWS will likewise advise KWP II on appropriate measures to avoid any inadvertent harm or harassment of non-nesting birds, family groups, and individuals or flocks that are discovered during the clearing surveys.

Discovery During Construction

Even with timely surveys, it is possible that construction activities could encounter birds or nests that were not discovered during an initial clearing survey. If a nest or evidence of nēnē nesting activity is discovered during construction, all work in the vicinity of the discovery shall cease immediately and DOFAW and USFWS shall be contacted.

Thereafter, the same case-by-case protocol as described in the section above (Discovery During Clearing Surveys) will be followed. Construction may be allowed to resume in adjacent areas beyond the established nest protection bufferbuffer if agreed by DLNR, USFWS, and KWP II that such activity is not expected to result in adverse impacts or disturbance; temporary fencing, other protective barrier, or suitable marking strategy may be required along with subsequent monitoring; or, the nest may be relocated by agency officials.

Education

DOFAW and Kaheawa Wind Power II have agreed that it would be beneficial to coordinate pre-construction educational and training sessions with all construction workers, inspectors, and site managers to provide information about nēnē, with an emphasis on their nesting and foraging habits, general disposition and behavior, and overall ecology in the Kaheawa Pastures region. Kaheawa Wind Power II is also implementing a Wildlife Education and Observation Program (WEOP) under the HCP that ensures each individual contractor and their designees are provided with the necessary information on the occurrence and behavior, guidelines for reporting observations and occurrences of birds around work areas and roads of nēnē while working and traveling I

REPORTING

Kaheawa Wind Power II will present written results of daily surveys performed throughout the construction phase of the project to DOFAW and USFWS on a weekly and as-requested basis to ensure steady and useful exchange of information on the status of monitoring efforts and levels of nēnē interaction with construction activities. A final report summarizing the results of construction phase nēnē monitoring will be prepared and presented to DOFAW and USFWS when construction activities are complete.

Appendix 13

(Pending)

Appendix 14

Downed Wildlife Protocol

Kaheawa Wind Power II

Habitat Conservation Plan

Purpose	To identify and document any wildlife injury or fatality incident that involves Covered and MBTA Species at the Kaheawa Wind Power II site incidental to and during regular monitoring.
Applicability	This protocol applies to all employees of Kaheawa Wind Power II and its affiliates, and extends to all consultants, contractors, or other personnel who work on the site.
Covered Species	Covered Species include the federally <i>endangered</i> Hawaiian Petrel, Hawaiian goose, Hawaiian Hoary Bat, and the federally <i>threatened</i> Newell's Shearwater. MBTA species include all species covered under the provisions of the federal Migratory Bird Treaty Act.
Overall Approach	<p>Downed wildlife may be located during the course of regular monitoring or opportunistically during routine site work. In addition to the project's monitoring program, which is a component of the project's Habitat Conservation Plan, project consultants and personnel will routinely look for and exhibit awareness of the potential to encounter downed wildlife when working at individual turbine sites, when traveling along site roads by vehicle, and when traveling the site on foot. Should any downed wildlife be found or reported, the responsible party (Senior Wildlife Biologist, Site Compliance Officer, or their official designee) shall contact Maui DLNR Forestry and Wildlife Division and USFWS immediately to initiate response coordination:</p> <p>Maui Wildlife Program Manager at 808-873-3510 (John Medeiros) or 808-873-3502 (Fern Duvall).</p> <p>USFWS Wildlife Biologist at 808-792-9433 (James Kwon)</p> <p>A written report that provides documentation and details of the incident will be submitted to DLNR/DOFAW and USFWS within 3 business days following the incident.</p> <p>All downed wildlife will be left in place until agency personnel arrive or unless directed by USFWS or DLNR personnel. Injured wildlife may require, if instructed directly by DLNR or USFWS, that the responsible party transport the downed individual in an appropriate container (e.g. ventilated pet carrier) either to a qualified veterinarian or other facility specified by DLNR or USFWS, as described below, as soon as possible and appropriate (e.g., if the individual is alive, it shall be transported immediately). The responsible party will also complete a Downed Wildlife Monitoring Form and an official Incident Report will be submitted to DLNR and USFWS within 3 business days following the incident.</p>
Facility Information	TBD Phone:
Kaheawa Wind Power II Contact Information	Gregory Spencer, Senior Wildlife Biologist Phone: (808) 298-5097

Kaheawa Wind Power II, LLC

Habitat Conservation Plan – Downed Wildlife Incident Documentation Form

SAMPLE

Observer Name:	
Date:	
Species (common name):	
Time Observed (HST):	
Time Initially Reported (HST):	
Time Responders Arrive (HST):	
Location:	
GPS Coordinates (specify units and datum):	
Date Last Surveyed:	
Distance to Base of nearest WTG:	
Bearing from Base of nearest WTG:	
Ground Cover Type:	
Wind Direction and Speed (mph):	
Cloud Cover (%):	
Cloud Deck (magl):	
Precipitation:	
Temperature (°F):	

Condition of Specimen:
Probable Cause of Injuries and Supportive Evidence:
Action Taken:

Appendix 15

BIOLOGICAL RESOURCES SURVEY
KAHEAWA WIND ENERGY PROJECT 2 (KWP2)
KAHEAWA, MAUI, HAWAII

by

ROBERT W. HOB DY
ENVIRONMENTAL CONSULTANT
Kokomo, Maui
January 2010

Prepared for: FIRST WIND ENERGY, LLC

INTRODUCTION

Kaheawa Wind Energy Project 2 (KWP2) lies on Kaheawa Ridge on the southern tip of West Maui just west of Manawainui Gulch between the elevations of 1,800 feet and 2,700 feet. This project consists of one approximately 1,500 ft. long corridor for the installation of an underground cable system and two small areas where project related structures are planned. This study has been initiated by First Wind Energy LLC to assess the botanical resources of the project area in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

Kaheawa Ridge has moderately sloping terrain that descends to the sea at a roughly 16% grade. Vegetation is mostly grasslands and low shrubby cover with a few small scattered trees. Soils are characterized as Oli Silty Clay Loam, 10 – 30% slopes (OMB), which is a moderately deep soil formed from volcanic ash, as well as Rocklands (rRK) which are broken and uneven and with some eroded areas (Foote et al, 1972). This area is often windy, and has an annual rainfall that averages 30 inches to 40 inches with the bulk falling during the winter months (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this part of the mountain slope was entirely covered with native vegetation of low stature with dry grass and shrub lands and with a few trees in the gullies. The Hawaiians made some uses of forest resources here and had a cross-island trail cresting the ridge at 1600 ft. elevation. This trail was upgraded during the mid-1800s and used as a horse trail to Lahaina. It was resurrected to use in recent years and is the present Lahaina Pali Trail.

Cattle ranching began in the late 1800s and continued for over 100 years. During this time the grazing animals consumed much of the native vegetation which was gradually replaced by hardy weed species.

During the 1950s high voltage power lines were installed across the mountain along with access roads through this area. Increased traffic brought more disturbances and weeds. Fires became more frequent, further eliminating remnant native vegetation.

With the cessation of cattle grazing a number of grass and weed species have proliferated, creating a heightened fire hazard. Large fires have swept across the mountain consuming thousands of acres including the entire project area several times.

DESCRIPTION OF VEGETATION

The vegetation within the project area is a diverse array of grasses and low shrubs with a scattering of small trees. Five species are common throughout: molasses grass (*Melinis minutiflora*), Natal redbud (*Melinis repens*), u'ulei (*Osteomeles anthyllidifolia*), 'a'ali'i (*Dodonaea viscosa*) and lantana (*Lantana camara*). A total of 57 species were recorded during the survey.

Sixteen species of native plants were found in the project area: they include the u'ulei and 'a'ali'i as well as (*Carex wahuensis* subsp. *wahuensis*) no common name, ko'oko'olau (*Bidens micrantha* subsp. *micrantha*), naupaka kuahiwi (*Scaevola gaudichaudii*), 'akoko (*Chamaesyce celastroides* var. *amplectens*), 'öhi'a (*Metrosideros polymorpha* vars. *Glaberrima* and *incana*), 'iliahi alo'e (*Santalum ellipticum*), kilau (*Pteridium aquilinum* var. *decompositum*), koali awahia (*Ipomoea indica*), pükiawe (*Leptecophylla tameiameia*), 'ilima (*Sida fallax*), 'uhaloa (*Waltheria indica*) and huehue (*Osteomeles anthyllidifolia*). The remaining 41 plant species were non-native grasses, shrubs and trees.

SURVEY OBJECTIVES

This report summarizes the findings of a botanical survey of the Kaheawa Pastures Wind Energy Project which was conducted in January 2010. The objectives of the survey were to:

1. Document what plant species occur on the property or may likely occur in the existing habitat.
2. Document the status and abundance of each species.
3. Determine the presence or likely occurrence of any native plant species, particularly any that are federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora in this part of the island.
5. Note which aspects of the proposed development pose significant concerns for plants and recommend measures that would mitigate or avoid these problems.

SURVEY METHODS

The entire project area was surveyed on foot. Areas on rocky gully slopes were examined more intensively as these were the places where the most native plants survived both the grazing of cattle and the effects of wildfires. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of the ferns are in accordance with Palmer (2003) and the flowering plants are in accordance with Wagner et al. (1999) and Staples and Herbst (2005).

For each species, the following information is provided:

1. Scientific name with author citation
2. Common English or Hawaiian name.
3. Bio-geographical status. The following symbols are used:

endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.

indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

Polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.

non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:

abundant = forming a major part of the vegetation within the project area.

common = widely scattered throughout the area or locally abundant within a portion of it.

uncommon = scattered sparsely throughout the area or occurring in a few small patches.

rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
DENNSTAEDTIACEAE (Bracken Family)			
<i>Pteridium aquilinum</i> (L.) Kuhn var. <i>decompositum</i> (Gaud.) R.M. Tryon	<i>kilau</i>	endemic	rare
MONOCOTS			
CYPERACEAE (Sedge Family)			
<i>Carex wahuensis</i> C.A. Meyen subsp. <i>wahuensis</i>	-----	endemic	uncommon
POACEAE (Grass Family)			
<i>Bothriochloa barbinodis</i> (Lag.) Herter	fuzzy top	non-native	rare
<i>Bothriochloa pertusa</i> (L.) A. Camus	pitted beardgrass	non-native	uncommon
<i>Cynodon dactylon</i> (L.) Pers.	Bermuda grass	non-native	rare
<i>Digitaria insularis</i> (L.) Mez ex Ekman	sourgrass	non-native	rare
<i>Hyparrhenia rufa</i> (Nees) Stapf	thatching grass	non-native	uncommon
<i>Melinis minutiflora</i> P. Beauv.	molasses grass	non-native	common
<i>Melinis repens</i> (Willd.) Zizka	Natal red top	non-native	common
<i>Panicum maximum</i> Jacq.	Guinea grass	non-native	rare
<i>Paspalum dilalatum</i> Poir.	Dallis grass	non-native	rare
<i>Pennisetum clandestinum</i> Chiov.	Kikuyu grass	non-native	rare
<i>Sporobolus africanus</i> (Poir.) Robyns & Tournay	smutgrass	non-native	uncommon
DICOTS			
ANACARDIACEAE (Mango Family)			
<i>Schinus terebinthifolius</i> Raddi	Christmas berry	non-native	uncommon
ASTERACEAE (Sunflower Family)			
<i>Acanthospermum australe</i> (Loefl.) Kuntze	spiny bur	non-native	rare
<i>Bidens micrantha</i> Gaud.	<i>ko'oko'olau</i>	endemic	uncommon
<i>Cirsium vulgare</i> (Savi) Ten.	bull thistle	non-native	rare
<i>Conyza bonariensis</i> (L.) Cronq.	hairy horseweed	non-native	uncommon
<i>Emilia fosbergii</i> Nicolson	red pualele	non-native	rare
<i>Heterotheca grandiflora</i> Nutt.	telegraph weed	non-native	rare
<i>Hypochoeris radicata</i> L.	gosmore	non-native	rare
<i>Senecio madagascariensis</i> Poir.	fireweed	non-native	uncommon
BRASSICACEAE (Mustard Family)			
<i>Lepidium virginicum</i> L.	pepperwort	non-native	rare
<i>Sisymbrium altissimum</i> L.	tumble mustard	non-native	rare
CACTACEAE (Cactus Family)			
<i>Opuntia ficus-indica</i> (L.) Mill.	<i>panini</i>	non-native	rare
CASUARINACEAE (She-oak Family)			
<i>Casuarina equisetifolia</i> L.	common ironwood	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
<i>Casuarina glauca</i> Sieber ex Spreng CONVOLVULACEAE (Morning Glory Family)	longleaf ironwood	non-native	uncommon
<i>Ipomoea indica</i> (J. Burm.) Merr. ERICACEAE (Heath Family)	<i>koali awahia</i>	indigenous	rare
<i>Leptecophylla tameiameia</i> (Cham. & Schlect.) C.M. Weiller	<i>pūkiawe</i>	indigenous	uncommon
EUPHORBIACEAE (Spurge Family) <i>Chamaesyce celastroides</i> (Boiss.) Croizat & Degener var. <i>amplectens</i> (Sherff) Degner & I. Degener	<i>'akoko</i>	endemic	uncommon
FABACEAE (Pea Family) <i>Acacia farnesiana</i> (L.) Willd.	klu	non-native	rare
<i>Chamaecrista nictitans</i> (L.) Willd.	partridge pea	non-native	uncommon
<i>Indigofera suffruticosa</i> Mill.	<i>'inikō</i>	non-native	rare
<i>Leucaena leucocephala</i> (Lam.) de Wit	<i>koa haole</i>	non-native	rare
<i>Macrotidium lathyroides</i> (L.) Urb.	wild bean	non-native	rare
<i>Neonotonia wightii</i> (Wight & Arnott) Lackey	glycine	non-native	rare
GOODENIACEAE (Goodenia Family) <i>Scaevola gaudichaudii</i> Hooker & Arnott	<i>naupaka kuahiwi</i>	endemic	rare
MALVACEAE (Mallow Family) <i>Malvastrum cormandelianum</i> (L.) Garcke	false mallow	non-native	rare
<i>Sida fallax</i> Walp.	<i>'ilima</i>	indigenous	uncommon
<i>Triumfetta semitriloba</i> Jacq.	Sacramento bur	non-native	uncommon
<i>Waltheria indica</i> L.	<i>'uhaloa</i>	indigenous	uncommon
MENISPERMACEAE (Moonseed Family) <i>Cocculus orbiculatus</i> (L.) DC.	<i>huehue</i>	indigenous	rare
MYRTACEAE (Myrtle Family) <i>Metrosideros polymorpha</i> Gaud. var. <i>glaberrima</i> (H.Lev.) St. John	<i>'ōhi'a</i>	endemic	uncommon
<i>Metrosideros polymorpha</i> Gaud. var. <i>incana</i> (H. Lev.) St. John	<i>'ōhi'a</i>	endemic	rare
<i>Psidium guajava</i> L.	common guava	non-native	rare
OXALIDACEAE (Wood Sorrel Family) <i>Oxalis corniculata</i> L.	yellow wood sorrel	Polynesian	rare
PLANTAGINACEAE (Plantain Family) <i>Plantago lanceolata</i> L.	narrow-leaved plantain	non-native	uncommon
POLYGALACEAE (Milkwort Family) <i>Polygala paniculata</i> L.	milkwort	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
PROTEACEAE (Protea Family)			
<i>Grevillea robusta</i> A. Cunn. ex R. Br.	silk oak	non-native	rare
ROSACEAE (Rose Family)			
<i>Osteomeles anthyllidifolia</i> (Sm.) Lindl.	u'u lei	indigenous	common
SANTALACEAE (Sandalwood Family)			
<i>Santalum ellipticum</i> Gaud.	'iliahialo'e	endemic	rare
SAPINDACEAE (Soapberry Family)			
<i>Dodonaea viscosa</i> Jacq.	'a'ali'i	indigenous	common
SOLANACEAE (Nightshade Family)			
<i>Solanum linnaeanum</i> Hepper & P. Jaeger	apple of Sodom	non-native	rare
THYMELAEACEAE ('Akia Family)			
<i>Wikstroemia oahuensis</i> (A.Gray) Rock	'akia	endemic	uncommon
VERBENACEAE (Verbena Family)			
<i>Lantana camara</i> L.	lantana	non-native	common
<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Jamaica vervain	non-native	uncommon
<i>Verbena littoralis</i> Kunth	ha'uöwi	non-native	rare

DISCUSSION

The excavation of a 1,500 foot long trench in which to install an underground electrical transmission cable will result in the loss of some native vegetation within a narrow corridor between turbines 12 through 20. Much less native vegetation will be impacted by the construction of additional project structures at a proposed substation near turbine 12 and an extension to the office building at the project baseyard, as these two sites are nearly entirely covered with non-native grasses. None-the-less, the area in general has experienced a dramatic loss of native plant communities over the last century and there is concern that further losses of rare species and special habitats be avoided. The proposed project was analyzed with these concerns in mind.

Of the 16 native plant species identified within the project area none were found to be federally listed as Threatened or Endangered species (USFWS, 2009), nor were any found that are candidates for such status. All but one of these native species are common throughout the state. One, *Bidens micrantha*, is found only on Maui and Lanai but is quite common in West Maui.

Most of these native plants are in low shrubland communities that are most prevalent on rocky slopes on the West side of Manawainui Gulch. This is due to the fact that these areas were less accessible to grazing cattle over the years and because these rather barren, rocky slopes are less susceptible to fires. While a few of the native shrubland communities within the project corridor have a variety of native species, none can be considered special habitats or associated with a rare or protected species.

It is likely that periodic fires will continue to be a problem into the foreseeable future. The area has been nearly completely overtaken by molasses grass, a highly flammable, fire-adapted species that is quick to recover following wildfires. Meanwhile, each fire destroys more and more of even the hardiest native plants. Unless land management practices change dramatically across this dry mountain slope, little improvement in this prognosis is likely.

Previous botanical surveys on this southern tip for West Maui have identified a few Endangered species growing in gulches about a mile upslope of this project area. This area is remote from these populations and is in a habitat completely unsuitable for their growth and survival. This project is not expected to negatively impact any of these species.

Due to the general condition of the habitat and the specific lack of any environmentally sensitive native plant species or habitats on or near the project area, the proposed development work is not expected to result in any significant negative impact on the botanical resources in this part of Maui.

RECOMMENDATIONS

Sensitivity toward the remnant native plant communities on the steeper slopes should be exercised in selecting the route for the underground cable. The gentler slope near the edge of the ridgetop would be preferable.

It is recommended that some of the native plant species found in this area be used to revegetate berms and banks resulting from construction activities.

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Appendix 16

Calculation of Total Direct Take at Kaheawa Wind Power

The following are excerpts from the Kaheawa Wind Power Year 3 Annual Report:

"As presented in Section V of the HCP, the principle components that go into estimating the Adjusted Take are, a) Observed Direct Take, b) Unobserved Direct Take, c) Indirect Take, and d) Loss of Productivity. The SEEF and Carcass Removal results are used to estimate the Unobserved Direct Take (UDT). To calculate adjusted estimates of the number of Hawaiian Hoary Bat and Nene fatalities that may have occurred at KWP during the present reporting period, we used an estimator, m , as proposed by Shoefeld (2004) and Kerns and Kerlinger (2003) to estimate fatality rates using the formula:

$$m = \left(\frac{N * I * C}{k * t * p} \right) \left(\frac{e^{I/t} - 1 + p}{e^{I/t} - 1} \right)$$

where I represents the number of days between plot searches (search interval), N is equal to the number of turbine search plots, k is the number of plots searched (in the case of KWP, N and k are the same value), t is the mean carcass retention time, p is used to represent the detection probability (searcher efficiency), $e^{I/t}$ is an exponential value, and C is the actual number of carcasses observed (ODT) during downed wildlife monitoring."

Example from KWP Year 3 Annual Report

Hawaiian Hoary Bat

Observed Direct Take (C) = 1

Total Search Plots (N) = 20

Number of Plots Searched (k) = 20

Search Interval (I) = 7.6

Carcass Retention Time (t) = 10

Carcass Detection Probability (p) = 0.58

Natural Log ($e^{I/t}$) = 2.138276

$$m = \left(\frac{N * I * C}{k * t * p} \right) \left(\frac{e^{I/t} - 1 + p}{e^{I/t} - 1} \right)$$

$$m = 1.978$$

The total adjusted take at KWP is presented below (modified from Table 3 of the KWP Year 3 Annual Report) in Table 1.

Table 1. Total Adjusted Take for KWP

Species	FY08			FY09			Total	
	Observed Take	Month and Year	Adjusted Take	Observed Take	Month and Year	Adjusted Take	Total Adjusted Take	Yearly Total Adjusted Take ¹
Nene	1	7-Dec	1.6	1	9-Jun	1.21	4.22	1.21
	1	7-Oct	1.41					
Hawaiian Petrel	1	7-Aug	1.74	0			1.74	0.50
Newell's Shearwater	0			0			0	0.00
Hawaiian Hoary Bat	0			1	8-Sep	1.98	1.98	0.57

¹ The Yearly Total Adjusted Take is the yearly average based on 42 months (3.5 years) of observations since permit issuance in January, 2006

Appendix 17

**An Assessment of Native Hawaiian Molluscan Fauna
Kaheawa Pastures, West Maui, Hawaii**

Kaheawa Wind Power II: Part 2

TMK 4-8-001:001 and 3-6-001:014

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Introduction:

The terrestrial molluscan fauna of Hawai‘i is in a state of catastrophic decline in which hundreds of species and an endemic family are in danger of extinction. Hawai‘i’s molluscs evolved in isolation with an ecological naivety that has left them extremely vulnerable to environmental change, and a low fecundity that has not allowed them to recover from the pressures exerted by introduced predators. During the late 20th century perhaps as many as two-thirds of the living species described in the 19th and early 20th centuries became rare or extinct.

This survey was commissioned by Kaheawa Wind Power II (KWP II) to determine if any species of native Hawaiian snails, particularly those species federally and state listed as threatened, endangered or of substantial conservation concern occur within the proposed underground collection system routing, BESS and sub-station enclosures, expanded Operations and Maintenance facilities, and proposed water storage tank, and if so what steps could be taken to ensure their continued survival.

Survey Objectives:

This survey and report were initiated out of concern that there may be native snail populations within the proposed KWP II underground collection system routing, BESS and sub-station enclosures, expanded Operations and Maintenance, and water storage tank facilities. The objectives were to determine if any native land snail species were present in these proposed project areas, to identify them and to determine their habitat. Another objective was to look for semi-fossil shells protected beneath rocks or buried in the soil, which could indicate what species might have been present in the area in recent years, and thus may still be present.

Site Description:

The survey area was restricted to the eastern side of the lower portion of the Kaheawa Pastures within the existing Kaheawa Wind Power (KWP) leased area. The survey encompassed a 750-meter-long by 50-meter-wide corridor beginning at turbine number 20 at approximately 546 meters and extending uphill parallel to the western edge of Manawainui Gulch and bordering the existing KWP string road to turbine 12. It also included a proposed building expansion site measuring 18 by 24 meters which is beside an existing structure housing offices and equipment (Operations and Maintenance facility) and a section of pasture to the east of the present Operations and Maintenance facility where a water storage tank is proposed.

Kaheawa Pasture lies in the Lahaina District in the ahupua‘a of Ukumehame. It is defined by the upper reaches of Papalaua Gulch and its tributaries on the west and by Manawainui Gulch to the east and south. Much of the pasture was burned in 2006 in the most recent of many wind-driven fires to pass through the area.

Within the survey area there are areas of fire-stunted, native shrubs and some native and introduced grasses. A very shallow layer of leaf litter was found beneath the shrubs which rested on a layer of burnt plant material presumably from the last fire. A couple of small stands of ironwood trees found within the survey area blanket the ground with their needles preventing the growth of other plants resulting in very poor snail habitat.

When exposed, much of the stratigraphy is relatively constant in appearance with a brown layer of recent soil resting on a layer of hard-packed reddish-brown soil-like material. The upper layer was the most likely to contain evidence of snails in the form of semi-fossil shells of recent species; however none were found.

Though naturally occurring rock formations were abundant, they rested on the hard-packed ground mentioned above with pockets of ash in the cracks between the rocks. Very seldom did grass root-mats of any substantial depth form around or beneath the rocks. This grass root-mat and rock combination provides good snail habitat and can protect small snails living deep in the grass root-mat from fast-moving fires which sweep across the rocks burning exposed grass leaves, but not the root-mat.

Biological History:

[The following paragraphs are copied from my first assessment of the Kaheawa Pastures in January 2009. They are repeated here because the area of this survey is adjacent to and part of the original Kaheawa Pastures which was surveyed in January, 2009.]

Prior to European contact much of the pasture was probably blanketed by the horizontally-growing uluhe fern with scattered trees, predominantly ohia (*Metrosideros polymorpha*), as on the nearby ridges today.

Uluhe fern often acts as a fringe forest plant on mountain slopes and ridge tops. It is intermediate between the forest and the lowland vegetation and is often the dominant plant in that role. Because of the steep inclination of the ridges of West Maui's lee side, uluhe forms an obvious broken line of bright green on the ridge backs beneath the forest. Its regularity in elevation and growth patterns permits a reasonable expectancy from one ridge to the next at the same elevation. Thus by comparing nearby ridges of similar elevation to the Kaheawa Pastures survey area it is possible to imagine what the vegetation of the pasture may have looked like in the past.

Since West Maui is heavily eroded into distinct ridges separated by deep valleys, populations of species living on the ridge tops are isolated and develop characteristics in shape and color that are unique to each population. Thus, if snails had existed in the Kaheawa Pastures they would have had distinct characteristics and would have been interesting to early collectors as subspecies. An intensive search of the collecting data showed that all of the collected variations of arboreal snail species that I would have expected to find in the survey area had data indicating their origin, but none of that data mentions Kaheawa Pastures or Ukumehame.

The nearest location for which snail collecting data exist is along the ridge overlooking Ukumehame Valley on the trail leading to the reservoir at Hana'ula, parallel to but at a higher elevation than the Kaheawa Pastures. There, *Partulina fusioidea* was collected and still exists today. It was described in 1855 by Newcomb.

Knowing that collections were made on an adjacent and parallel ridge on the Wailuku side of the survey area in 1855, and that in 1978 semi-fossil *Partulina* were found in the soil along the Wailuku edge of that adjacent pasture at the elevation of the upper survey area, I would expect a subspecies or variation of that species to have lived in the area that the Kaheawa Pastures occupies today. Having no collecting data nor specimens whose location is unaccounted for and could be attributed to the Kaheawa Pastures suggests that the Kaheawa Pastures was unproductive for snail hunters before 1855.

One explanation for the lack of specimens is that the pastoral history of the pasture predates the study of snails in the area. The snail fauna of the pasture can be inferred from surrounding areas, but without living snails or fossil snail deposits it will not be possible to know what the pasture was like prior to what is known historically and what is there today.

Habitat Requirements for Ground dwelling Snails:

The habitats preferred by ground-dwelling snails are a moist environment beneath rocks and rock talus, often associated with the root-mats of grasses; in the leaf litter beneath trees and shrubs, and in thick mosses growing on the ground, on trees and among rocks.

Conservation Relevance:

It is highly unlikely that native snails, including those which receive protection under state or federal endangered species laws will be found in the Kaheawa Pastures. However, all of the native Hawaiian land snails should be considered rare and treated as such if discovered, with particular attention given to their habitat.

Discussion:

Since all of the habitats expected to be occupied by ground-dwelling snails are seriously degraded or non-existent within the surveyed area and since there is no habitat for arboreal snails, it is highly unlikely that living snails exist within the surveyed area.

The attention First Wind and Kaheawa Wind Power II has given to this important but devastated aspect of Hawaiian biology is commendable, but it appears that years of abuse of the land, along with tell-tale hints of pastoral use pointing back to before the 1850's, seem to have reduced the capacity of the area to support living snails.

Conclusion:

During the survey the leaves, bark and leaf litter beneath shrubs were searched. In addition, grass root-mats among and beneath rock talus and other naturally occurring rock formations were also searched for evidence of snails. The limited amount of moss was examined, and exposed ground was searched for fresh and dead shells. No snail shells, fossil or extant, native or introduced, were found.

After the meticulous search described, my assessment is that there are no living snails, native or introduced, within the area surveyed.

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